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LACHNOSTERNA LARVÆ AS A POSSIBLE FOOD SUPPLY

By L. O. HOWARD

This seems a favorable time to consider the question of new and cheap food supplies. With increasing prices of the old staple foods practically all over the world, with many nations facing very serious shortages on account of war conditions, it would seem that practical suggestions concerning any new cheap food should be especially welcome.

Doubtless many foods now considered excellent were first discovered by starving people. Possibly oysters, clams, snails, crabs, lobster, crawfish and shrimp were first eaten by people who could get no other food. Many things are eaten by semi-civilized people, and even by such nations as the Chinese and Japanese, which Europeans, and especially the Anglo-Saxons, would not think of touching under ordinary circumstances.

Many different insects are eaten in barbarous and semi-civilized countries, and it is certain that the Romans at the height of the luxury of the Empire ate certain insect larvæ as delicacies. There is in fact a rather extensive literature concerning the edibility of insects, based, however, in the main upon historical facts and upon their use among wild people, and containing few or no accounts of practical experiments under modern conditions.[1]

These facts point out the desirability of just such experiments, and practically all our colleges of agriculture, with their departments of home economics and of entomology, are in excellent position to do just this work. First, the edibility of the principal species abundant enough to furnish a good supply must be tested, and when the edibility

[1] Miss Colcord, the Librarian of the Bureau of Entomology of the United States Department of Agriculture, is preparing a complete bibliography of this subject for publication in the near future.

of any one or more of them has been established, careful scientific work on their relative food value must be carried out.

Two kinds of insects from the viewpoint of abundance and possible food value at once suggest themselves, namely, grasshoppers and the larvæ of Lachnosterna in this country and of Melolontha in Europe—the so-called "white grubs."

Grasshoppers have been eaten by so many different peoples that their value as food may readily be accepted, but with white grubs it is reasonable to suppose that the civilized world will have to be convinced. They abound in all grain-growing regions of the United States, and a boy following the plough, if their edibility is once established, would be able to pick up a day's rations for the family in a short time.

With all this in view I have been carrying on a few experiments which I think should be placed on record.

Recently Mr. J. J. Davis, with the help of Professor J. G. Sanders, collected the larvæ of Lachnosterna near Madison, Wisconsin, and Mr. Davis prepared them by clipping off the extreme anal end, at the same time holding them under a running stream of water and pressing the body gently to remove the grit and intestinal parts, leaving them pure white pieces of flesh. They were then placed in a pint jar of salty water (one and one-half teaspoons of salt to a pint of water), and then sterilized under an autoclave at twenty pounds for thirty minutes. They were then sent to Washington in a glass jar. On arrival in Washington they were turned over to Dr. C. F. Langworthy, Chief of the Office of Home Economics of the States Relations Service, of the U. S. Department of Agriculture, who, after straining the grubs through a salt solution, washed them in cold water. He then removed the heads from half of them that one might judge whether one form was to be preferred, or whether both were alike good. They were treated generously with a French dressing made of salt, oil and vinegar, seasoned with white pepper, paprika and salt. Judging that an acid flavor would make the salad more palatable, the proportion of vinegar to oil was rather larger than the usual ratio of one to four or five.

He then made a broth by cooking the liquor strained from the grubs (approximately one-half pint, diluted with one gill of water) with one half onion and seasoned with a tablespoonful of butter and a few shreds of lettuce (a heaping teaspoonful).

The salad was eaten by Messrs. C. H. Popenoe, W. B. Wood, F. H. Chittenden, E. B. O'Leary, R. C. Althouse, W. R. Walton, C. E. Wolfe, and Herbert S. Barber of the Bureau of Entomology and Vernon Bailey of the Bureau of Biological Survey, as well as the writer. It was found very palatable, although in chewing, all of us discarded

the tough chitinous skin. Dr. Chittenden discovered a disagreeable taste which none of the rest of us noticed. He tried only one, and possibly that one may have been a little spoiled. The broth was drunk by Mr. O'Leary and the writer, and we both agreed that it was not only perfectly unobjectionable but really appetizing.

This experiment was made May 17.

A week later Mr. Davis sent in from Lafayette, Indiana, a bottle containing more than 100 grubs preserved in rendered butter, that is, the butter was heated until the water was gone and the casein of the milk had settled and was then strained. The grubs were dressed as previously and were then brought to the boiling point in the rendered butter and bottled. With his colleagues, Messrs. Fenton and Mason, Mr. Davis made a stew which he called delicious, as follows: the dressed grubs were heated in a small amount of water, after which milk was added and the broth seasoned with a small piece of butter, salt and pepper. They prepared the grubs as they thought oyster stew was prepared, and of course ate the grubs as well as the broth. Mr. Mason thought that it tasted very much like boiled crab meat and not much different from lobster. Mr. Fenton thought that it tasted much like lobster, but had not eaten crab and so was not in a position to judge whether they were more like the latter. Mr. Davis had never eaten either fresh crab or lobster, but thought that they had a decided seafood taste. All thought it "agreeable" and "were sorry when it was all gone."

The bottled grubs were sent to Washington, and in Dr. Langworthy's laboratory were made into a soup as follows: A quart of milk, a pint of water, three tablespoons of flour and salt and pepper for seasoning. One tablespoon of the fat in which the grubs had been preserved was browned with one tablespoon of flour. The grubs and the rest of the fat were put into the water and added to the heated milk along with the flour and seasonings.

This white grub stew was very appetizing. It was eaten by Messrs. E. B. O'Leary, C. E. Wolfe, C. H. Popenoe, Joseph Jacobs, A. B. Duckett, C. H. T. Townsend, C. S. Menagh, W. R. Walton, W. B. Wood, and the writer.

Most of us noticed no especially distinctive flavor. Dr. Townsend and the writer, who probably ate more of the grubs than the others, thought that we discovered a slightly acid flavor which is difficult to describe.

Analysis of the grubs will be made in the Office of Home Economics in the Department in order to ascertain their exact constituents from a food point of view, and it is hoped also to make digestion experiments to determine the proportion of the material that can be digested and

assimilated by the body. I feel sure that white grubs will be shown to have a positive food value, and am equally sure that the prejudice against insects as food is perfectly unreasonable.

Should any one following this experience be influenced to make any personal experiments the probable necessity for thorough sterilization of the grubs before use should be pointed out on account of the effects of possible pollution of the soil from which they came.

REDUCING THE COST OF COMMERCIAL SPRAYING

By R. S. Woglum, *U. S. Bureau of Entomology*

The question most frequently asked by the practical horticulturist regarding a spray for the control of insect pests or plant diseases is the cost of application. This cost is an important factor in balancing the profit and loss account, namely the possible increased crop value less cost of treatment compared with the loss from the pest if no treatment is given. The present article discusses briefly certain features of equipment which the writer has been using for more than a year with marked reduction in the cost of certain sprays.

One of the experimental plats used in an investigation of the control of mealybugs of citrus trees in southern California consisted of ten acres, and contained 1,125 trees. It was decided to use this plat in an experiment to control the mealybug by a water spray, the object being to wash the insects from the trees by water under high pressure. Experience having demonstrated that upwards of 100 gallons of water is frequently required for a single tree, it was apparent that very few trees could be properly sprayed in a single day with a power outfit, and, since three to five sprayings a year are necessary for effective work, it was evident that such water control would be very expensive. Furthermore, the contingency of one application closely following another brought up the question of impracticability, if not impossibility, of properly treating an orchard of this size with the one outfit at our disposal.

A very progressive grower near Pasadena had just installed a pipe system in his orchard through which to force water in mealybug control, and this method of distribution appeared of such practical value in treating large orchards that a pipe system was planned and immediately installed in our experimental plat. A plan of this system is shown in the accompanying figure. Some 2040 feet of $\frac{3}{4}$-inch pipe were laid at a depth of about one foot, with uprights for attaching faucets every fourth tree. A power sprayer having a 200-gallon tank was stationed at one side of the orchard adjacent a water main from

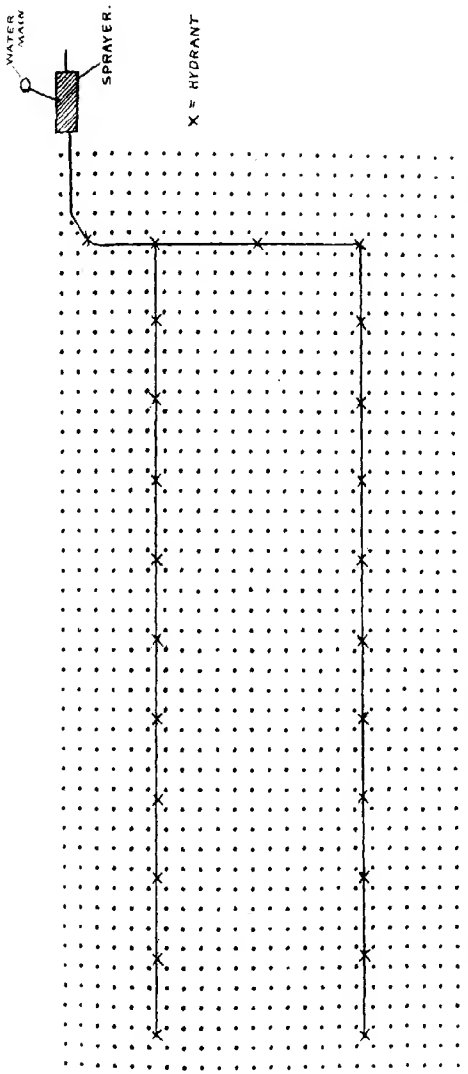


Fig. 22. Diagram of a pipe system in a 10-acre orange orchard by the use of which the cost of spray application was reduced about 75 per cent.

which the water was carried to the tank by an inch pipe and pumped directly into the underground system. Water was thus continuously available at any of the 24 hydrants, and these were so placed that with 150 feet of hose any tree in the orchard could be sprayed. Under this system there is no loss of time for refilling, and the cost of horses is eliminated.

The elements of cost in operating a portable power outfit are engine fuel, labor, and team. This does not include the wear and tear on the machine, which would be about equivalent whether stationary or in motion. Estimating on the basis of an 8-hour day, the actual cost of operation of a power sprayer, as experienced by the writer in southern California, is as follows: fuel averages, 40 cents (gasoline at 15 cents a gallon), labor, $4.00 (2 men at $2.00), team, $5.00; total, $9.40. Under the pipe system the elimination of a team reduces the daily cost of operation by $5.00, or over 50 per cent. Moreover, the avoidance of loss of time for refilling which is necessary with a portable outfit doubtless would amount to at least two hours a day, and results in an additional saving of more than $2.00 a day. The total cost of the application under a pipe system would probably average about 75 per cent less than with a portable sprayer in orchards adapted to this method. The total cost of the ¾-inch pipe system in our experimental orchard was $105.50, or 9½ cents per tree. The economy effected during the first treatment more than paid for this cost.

This system of piping was installed for the use of a pure water spray, but it became apparent to the writer that such a system offered great possibilities in the field of fungicide and insecticide spraying. A part of this orchard was successfully treated with distillate emulsion and with soap powder through the pipe system. Doubtless such sprays as lime-sulphur, nicotine and soap which do not require constant agitation before application could be readily used through long leads of pipe. Where a large acreage of plants requires treatment with such sprays, the installation of a suitable pipe system is likely to prove economical wherever the topography of the ground permits. Furthermore, this system covers fields of insecticide application which have in the past offered almost insuperable obstacles, namely, the treatment of truck crops on mucky land, or orchards on steep hillsides.

A system of piping adapted to each case should be worked out before attempted installation, and certain pertinent suggestions gained during our experimental work might be worth mentioning. The capacity of the pump of the average power sprayer (about 10 gallons a minute) is not adequate for a large pipe system though it would suffice for a few acres where not more than two or possibly four mist nozzles are to be used. To determine the capacity of the pump which should be

purchased, knowledge of the nozzle discharge at the required pressure as well as the loss by friction in the pipe are necessary. Nozzle discharge is easily determined with a spray pump and pressure gauge. The following table of loss by friction of water in pipes shows the loss in pounds pressure per square inch for each 100 feet in length due to friction.

Gallons per Minute	Sizes of Pipe—Inside Diameter, and Loss in Pounds Pressure per Square Inch for Each 100 Feet of Pipe				
	¾-inch	1-inch	1¼-inch	1½-inch	2-inch
5	3.3 lbs.	0.84 lb.	0.31 lb.	0.12 lb.	
10	13.0 lbs.	3.16 lbs.	1.05 lbs.	0.47 lb.	0.12 lb.
15	28.7 lbs.	6.98 lbs.	2.38 lbs.	0.97 lb.	
20	50.4 lbs.	12.3 lbs.	4.07 lbs.	1.66 lbs.	0.42 lb.
25	78.0 lbs.	19.0 lbs.	6.40 lbs.	2.62 lbs.	

It is seldom advisable to use less than inch pipe as the loss by friction in smaller sizes is too great. The main might well be constructed of 1¼-inch pipe. A large mixing tank automatically emptying into the spray tank is necessary to insure a continuous supply of insecticide or fungicide. Drainage outlets at the lowest levels should be provided for emptying the system after use. Where several fields of one or two acres each require spraying a surface system easily and quickly adjustable to be moved from one field to another might offer advantages with certain crops.

ADDITIONAL NOTES ON THE USE OF DUST SPRAYS AGAINST THE CORN-EAR WORM[1]

By JAMES W. McCOLLOCH, *Assistant Entomologist, Kansas State Agricultural Experiment Station*

In the JOURNAL OF ECONOMIC ENTOMOLOGY for April, 1915, the writer presented a paper on "Recent Results in the Use of Dust Sprays for Controlling the Corn-ear Worm." In this paper the following conclusions were drawn:

(1) The amount of corn-ear worm injury can be greatly reduced by the thorough dusting of the silks.

(2) The cost of dusting is prohibitive where corn is raised for grain and forage but is profitable where corn is grown for roasting ears, show purposes, or for seed.

[1] Contribution from the Entomological Laboratory, Kansas State Agricultural College, No. 19.

(3) Sixty-three per cent arsenate of lead is equally as effective as pure arsenate of lead and costs less.

Experimental work with dust sprays was continued in 1915 for the purpose of confirming the results of 1914 and determining the following points: (1) the number of applications necessary to control the corn-ear worm; (2) the value of different carriers for arsenate of lead, such as lime, flour, and sulphur; and (3) a comparison of 75 per cent arsenate of lead with 50 per cent arsenate of lead.

To determine the first point, eight plots of corn, each one-fifth of an acre in size, were selected. Plot 1 was dusted once, plot 2 twice, and so on to plot 8 which was dusted eight times. The dust used in this experiment consisted of 75 per cent arsenate of lead and 25 per cent sulphur, and was applied to the corn silks by shaking from an ordinary cheesecloth bag. Two check plots were used with this and the following experiments. The average of these two check plots is given in the tables. The results of the first experiment are given in Table I.

TABLE I[1]

Plot	Treatment	Cost			Per cent Ears Injured	Per cent Grains Injured	Mold and Fungous Injury	Yield
		Material	Labor	Total				
1	Dusted 1 time	$0.25	$0.19	$0.44	65.8	About 5	Bad	13.7 bu.
2	" 2 times	0.36	0.30	0.66	58.8	" 5	"	13.1 "
3	" 3 "	0.43	0.45	0.88	56.8	" 3	Moderate	13.2 "
4	" 4 "	0.71	0.61	1.32	54.7	" 3	"	12.7 "
5	" 5 "	0.95	0.67	1.62	49.6	" 2	Very little	13.6 "
6	" 6 "	0.84	0.82	1.66	47.6	" 1	" "	13.3 "
7	" 7 "	0.84	0.84	1.68	41.0	Less than 1	None	14.0 "
8	" 8 "	0.88	0.90	1.78	26.5	" " 1	"	12.8 "
Check					63.4	About 8	Bad	12.7 "

From the table it will be seen that there is a marked reduction in the percentage of ears injured with each additional dusting. The per cent of ears injured, however, does not represent the true amount of corn-ear worm injury. The number of grains injured and the damage done by the molds and fungi which accompany such injury more nearly represent the actual damage. It will be noticed in the table that these types of injury decrease as the number of dustings are increased. The results of this experiment confirm the results of the previous work in that from 40 to 50 per cent of the normal number of ears injured can be brought through without injury and that the grain and mold injury can be rendered practically negligible.

[1] The data in this and the following tables are based on one-fifth acre plots.

It has been suggested that some carrier, cheaper than sulphur, could be used with the arsenate of lead. In order to gather data on this point, two additional one-fifth acre plots adjoining the previous experiment were dusted, using flour and lime as carriers. Table II gives the results of this test.

TABLE II

Plot	Treatment	Cost			Per cent Ears Injured	Per cent Grains Injured	Mold and Fungous Injury	Yield
		Material	Labor	Total				
[illegible]	Dusted 8 times 75% A. of L. 25% sulphur	$0.88	$0.90	$1.78	26.5	Less than 1	None	12.8 bu.
9	Dusted 8 times 75% A. of L. 25% flour	1.04	0.95	1.99	33.1	About 2	Moderate	13.2 "
10	Dusted 8 times 75% A. of L. 25% lime	1.14	0.90	2.04	36.1	" 2	"	12.2 "
Check					68.4	" 8	Bad	12.7 "

From these results it will be seen that with the use of sulphur there was a lower percentage of ears injured and the cost of the treatment was considerably lower. Lime and flour did not seem to adhere to the silks and consequently a larger amount of material was used. There was considerable mold and fungous injury on plots 9 and 10 which would indicate that the sulphur plays an important part in the dust spray as a fungicide.

In order to confirm the statement in the previous paper that the 50 per cent arsenate of lead was not effective enough to warrant its use, a plot was dusted with equal parts of arsenate of lead and sulphur. The results of this experiment are shown in Table III.

TABLE III

Plot	Treatment	Cost			Per cent Ears Injured	Per cent Grains Injured	Mold and Fungous Injury	Yield
		Material	Labor	Total				
[illegible]	Dusted 8 times 75% A. of L. 25% sulphur	$0.88	$0.90	$1.78	26.5	Less than 1	None	12.8 bu.
11	Dusted 8 times 50% A. of L. 50% sulphur	0.81	0.94	1.75	40.4	About 2	Very slight	12.7 "
Check					68.4	" 8	Bad	12.7 "

The following conclusions may be drawn from the results obtained in these experiments:

(1) The percentage of corn-ear worm and mold injury decreases as the number of dustings are increased.

(2) The cost of dusting is prohibitive where corn is grown for grain or forage but is practical where corn is raised for roasting ears, show purposes, or for seed corn.

(3) Sulphur is superior to flour or lime as a carrier for arsenate of lead and there is some indication that it also serves as a fungicide.

(4) Fifty per cent arsenate of lead does not control the corn-ear worm as effectively as does 75 per cent arsenate of lead.

A NEW SPECIES OF ISOSOMA ATTACKING WHEAT IN UTAH[1]

By R. W. Doane, *Stanford University*

During the past two summers, while carrying on certain investigations in Utah, for the American Smelting and Refining Co., Department of Agricultural Investigations, I have had an opportunity to study the life-history and habits of different wheat-infesting *Isosoma*, and to note something of the effect of their work in the wheat fields.

In the so-called dry farm regions in Salt Lake Valley it is a common custom to plant wheat every other year, letting the fields lie fallow during the alternate years. Often, however, the fields are not plowed during the year that they are supposed to lie fallow, but are allowed to grow a volunteer crop which is sometimes more or less profitable. The plowing that is done at any time is usually with a disc plow and a large part of the straw and stubble is left on the surface of the ground.

It will at once be seen that such farm practices offer almost ideal conditions for the development of stem-infesting wheat pests, and it is not surprising to find the Isosomas doing an immense amount of injury there, sometimes reducing the crop yield to a small proportion of what it normally would be.

My attention was first called to these pests when I found the adults in considerable numbers in a field of winter wheat in May, 1914. Two species were collected at this time. One proved to be the well known wheat straw worm, *Isosoma grande*, the other species, as far as I can determine, is undescribed. Because the larvæ confine their attacks to the leaf-sheath, I have called the species *Isosoma vaginicolum*.

[1]Contribution from the Laboratories of the American Smelting and Refining Co., Department of Agricultural Investigations.

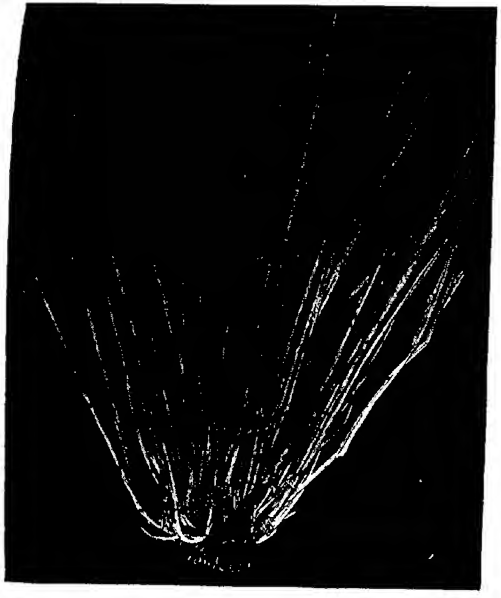


Fig. 1. Young wheat in which nearly all of the stems in the stool have been affected by *Isosoma vaginicolum*.

Fig. 2. Wheat straws that have become distorted on account of the work of *Isosoma vaginicolum*.

and have used the common name of "the wheat sheath worm." A brief description follows:

Isosoma vaginicolum n. sp.

Head, wholly opaque black, finely punctate, with fine white pile; antennæ black, basal segments faintly yellowish, especially below, the club somewhat shorter than the three preceding segments taken together, thorax black, finely punctate, in certain lights a faint yellowish spot may be seen on the anterior lateral corner of the prothorax; coxæ and trochanters black; femoræ of the first pair of legs black at base, yellowish toward the tip, in some instances nearly all of the distal half, especially below, is yellowish; femoræ of other legs black, yellowish at tip; anterior tibiæ yellowish, sometimes somewhat darker, especially below; other tibiæ blackish, yellowish at base and tip; tarsi yellow, last segment darker at tip; wings reaching to the tip of the abdomen; abdomen shining black, extreme tip (ovipositor sheath) yellowish; length 3 mm.; wing expanse 5½ mm. to 6 mm.

Isosoma grande, which is found in the same fields as *I. vaginicolum*, may easily be distinguished from the latter species by its large size and shining thorax. A few specimens of *I. tritici* were also found in this region. They may be distinguished from *I. vaginicolum* by the basal segment of the antennæ being wholly black and the club being

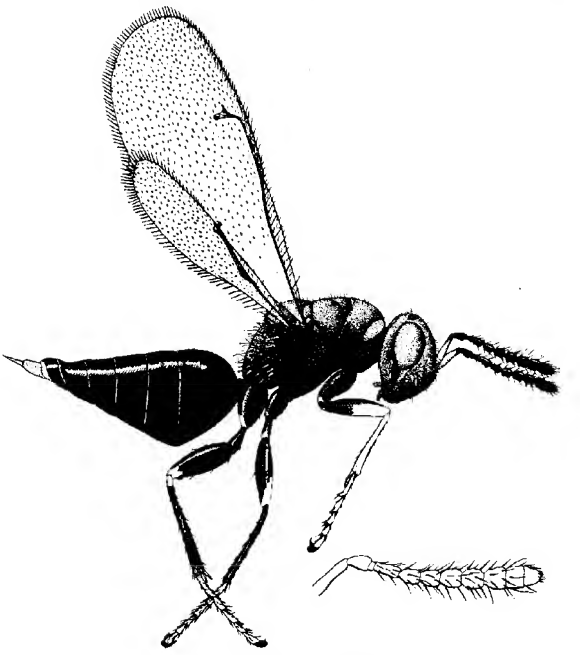


Fig. 23. *Isosoma vaginicolum.*

as long or longer than the three preceding segments taken together. The face of *I. tritici* is somewhat longer and the abdomen broader posteriorly, that is it is not quite as tapering as in *I. vaginicolum*.

Most of the adults of *I. vaginicolum* appear during the month of May. At this time they may be found laying their eggs in the base of the leaf-sheath just above one of the joints, usually near the middle of the stem. Three or four or often as many as fifteen or twenty eggs may be laid close together and when the larvæ begin to develop the leaf-sheath becomes more or less swollen. Each larva is enclosed in a firm little oval cell from a quarter of an inch to three eighths of an inch long. The swelling and hardening of the walls of the sheath presses on the stem in such a way as to prevent the sap from flowing through it readily and the plants become stunted and produce only small, poorly-developed heads. If the plants are badly affected or if they are infested early, they may produce no heads at all or the heads may never develop far enough to burst from the protecting leaf-sheath. In some fields eighty to ninety per cent of the wheat stems are infested and the crop loss will amount to from fifty to seventy-five per cent. I have seen some fields so badly injured that they were not considered worth the harvesting and the whole crop was a total loss. If the larval cells are very close to a joint they often cause conspicuous knots and the stem becomes much distorted. These swollen and distorted stems resemble very much the stems that have been injured by *I. tritici*, but a careful examination will show that the cells occur only in the leaf-sheath, whereas the larvæ of *I. tritici* are found in the walls of the stem of the plant.

The larvæ remain in the stems throughout the summer, fall and winter, and pupate in their cells during April and May. Most of the adults issue in May and early June.

I have found *Isosoma vaginicolum* only in the dry farm region. *I. grande*, which occurs with it there, has a much wider distribution, being found commonly in the wheat fields in the irrigated districts as well. In the well-tilled, well- irrigated fields, however, the injury that the wheat straw worm does is not as important or noticeable as it is in the dry farm regions, where the loss of the young plants due to the work of the first generation of larvæ, and the hardened thickened walls of the stems, due to the presence of the summer brood of larvæ, affects very seriously the quantity and quality of the yield of wheat. The effect of the work of this insect in the wheat fields in this state is similar to the conditions described by Webster and Reeves in Circular 106 of Bureau of Entomology.

I have found, both in Utah and California, that if a very young plant is attacked by the larvæ of the second generation it may be

destroyed or made to stool excessively, the effect being the same as produced by the work of the first generation of larvæ in the earlier wheat.

A little later, but still early, infestation with *I. grande* affects the height and size of the stem and the size of the head, usually making the head small or very small. An early infestation of the highest or next to highest joint affects the size of the head but does not appreciably affect the height of the stem. Infestation of the third joint does not seem to affect the plant as seriously as infestations higher or lower made at approximately the same time. A very late infestation may occur in one or even in two or three joints without seriously affecting the stem or the head.

NOTES ON RHOGAS TERMINALIS CRESS.

(*Hymenoptera, Braconida*)

By W. E. PENNINGTON, *Scientific Assistant, Cereal and Forage Insect Investigations*[1]

During the summer and fall of 1914 a very severe outbreak of *Cirphis* (*Heliophila*) *unipuncta* Haw. occurred at Hagerstown, Md. This outbreak was carefully investigated by the force of the United States Entomological Laboratory located at that point. Incidental to this work several parasites of the insect were reared. This paper deals with the data collected on one of these parasites, *Rhogas terminalis* Cress. (Fig. 21*a*), and is presented at this time because it throws a little additional light on the phenomenon of parthenogenesis.

During late September, October and early November, a large number of *Cirphis unipuncta* larvæ were collected from the field. These larvæ were isolated in tin salve boxes two inches in diameter and three quarters of an inch deep. As the larvæ were isolated, they were arranged by accession numbers which were marked with wax pencil on the top of the box. The cages were stored in galvanized iron trays (Pl. 30), were examined daily and fresh food supplied when necessary. In this way the data was exact from the time of collection of the original host to the completion of the experiment. From this material the initial series of *Rhogas terminalis* for the following experiments was obtained.

Table I gives the exact data relative to the emergence of the stock material.

The first note made at this Laboratory on *Rhogas terminalis* is dated August 7, 1914, on which date J. A. Hyslop collected nine adult fe-

[1] My thanks are due Mr. J. A. Hyslop for helpful suggestions and assistance in preparing the text and furnishing the illustrations; for the original adults making the experiments possible, and for the courtesies of full coöperation.

males and one male at the Laboratory trap light. Adults were collected throughout August, September and October by other members of the staff at the same light.

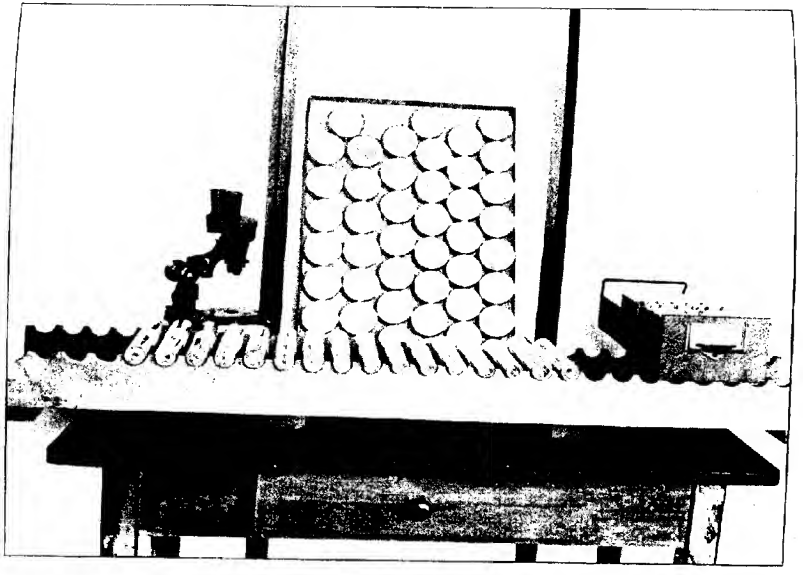
In 1915 the adults first appeared in mid-April. On March 30, H. L. Parker collected a puparium in the field, from which an adult emerged in the Laboratory April 9. On April 17 he collected a puparium from which the adult had but recently emerged, and on the 27th an adult was taken at the trap light and a pair swept in an alfalfa field. Adults were taken throughout May, June, July and August of 1915, so, with the 1914 data, it is evident that they are present in the field from mid-April to early November.

TABLE No. I

No.	Date of Collection of Larva	Date Parasite Formed Puparium	Date of Emergence of Adult Parasite	Date of Death of Adult Parasite	Sex of Parasite	Duration of Puparium Stage in Days	Length of Life of Adult in Days
	1914	1914	1914				
1	Sept. 22	Sept. 26	Oct. 13	Oct. 13, 1914	Female	17	1
2	Sept. 22	Oct. 2	Oct. 19	Nov. 30, 1914	Female	17	43
3	Sept. 22	Oct. 6	Oct. 23	Jan. 6, 1915	Female	17	75
4	Oct. 2	Oct. 6	Oct. 24	Nov. 30, 1914	Female	18	37
5	Sept. 23	Oct. 8	Oct. 31	Nov. 27, 1914	Female	23	27
6	Sept. 26	Oct. 13	Nov. 11	Jan. 19, 1915	Female	29	69
7	Oct. 2	Oct. 13	Nov. 7	Nov. 7, 1914	Female	25	1
8	Oct. 2	Oct. 19	Nov. 19	Jan. 5, 1915	Female	31	47
9	Oct. 2	Oct. 19	Nov. 17	?	?*	29	
10	Oct. 2	Oct. 19	Nov. 19	Jan. 27, 1915	Female	31	69
11	Oct. 20	Oct. 23	Nov. 19	Jan. 27, 1915	Female	27	69
12		Oct. 26	Nov. 20	Jan. 4, 1915	Female	25	45
13	Nov. 10	Nov. 16	Nov. 27	Dec. 8, 1914	Male	25	45

* Escaped.

Numbers 1 to 7 were kept under practically normal field conditions as to temperature, in a cold cellar. Numbers 8 to 13 inclusive were kept in the same cellar until the middle of November when they were removed to a heated room for the experiments which followed. All host larvæ used in these experiments, after obtaining the original parasite from a larva collected in the field, were reared from eggs laid in the Laboratory by moths which were themselves reared and mated in confinement. The host larvæ on hatching were isolated in the salve box cages and given accession numbers. It was found advantageous to place a piece of moist blotting paper in each box for the first two instars as dessication rapidly destroyed the very young larvae. By this method of procedure the exact age of every host larva exposed to a parasite was known and the possiblity of previous infestation by parasites precluded.



Apparatus used in *Rhogas terminalis* experiments: *a*. Galvanized iron tray holding 40 salve boxes; *b*. rack holding Doten cages; *c*. filing system unit for notes; *d*. binocular microscope.

The adult parasites were transferred to separate cages adapted from the cage described by Doten[1] (Pl. 30). A small piece of sponge soaked with honey water was put in daily. This liquid seemed a satisfactory food, so no other was tried.

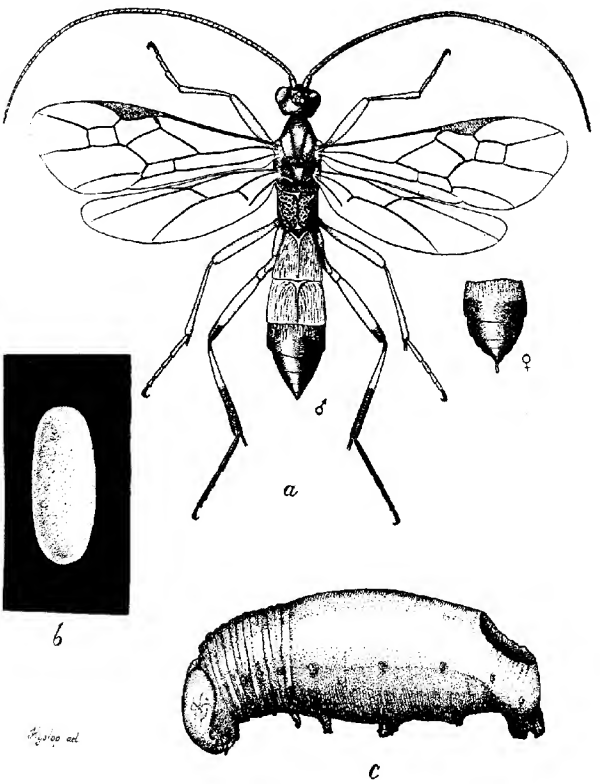


Fig. 24. *Rhogas terminalis* Cress.: *a*. adult; *b*. egg; *c*. puparium.

Into each of these cages the *Cirphis* larvæ were placed, one at a time. All relations between the parasite and its host were then carefully observed and recorded, the larva removed to its own cage, and the appearance and emergence of the subsequent parasite noted.

This parasite copulates immediately on emerging. The male, when the presence of a female is perceived, shows evident excitement by

[1]Doten, S. B., University of Nevada, Tech. Bul. 78, Sept., 1911.

vibrating the wings and antennæ. He very deliberately approaches the female and immediately copulates, the operation taking but about one minute. During copulation the male rapidly moves the head, tapping the raised antennæ of the female with his own, she remaining still in every member.

Oviposition rapidly follows copulation and is extremely rigorous. The female on locating a host larva raises with the fore legs the anterior part of her body, thrusts forward the abdomen between the legs and advances to striking distance. The strike is very rapid, the parasite rushing upon its host and inserting the ovipositor within a fraction of a second. The host resists. It bites, exudes a dark fluid from the mouth and squirms violently. Often the parasite will withdraw from its struggling host, but in a couple of seconds resumes its attack. It is possible that a deadening sting is inflicted with the first strike, and then oviposition is effected.

The egg (Fig. 24*b*) is elongate oval with the sides nearly parallel, the surface is finely rugose, and the color is glistening white semi-translucent. The egg measures .18 mm. in length and .09 mm. in diameter.

The puparium (Fig. 24*c*), as is the case with many species in this genus, is made of the transformed and reinforced larval skin of the host. The shape is fusiform with the ventral surface flattened and affixed to the object on which it rests by a black viscid exudation, the surface is turgid almost obliterating the segmentation of the host larval skin, the color is deep rufous brown to black. The length averages 9 mm. and diameter, 3 mm. The adult parasite emerges by gnawing an irregular hole caudad in the dorsum of the host skin.

For convenience in referring to the original mother-parasites, the females with which we began the experiments will be called "Rhogas 2," etc., and on up to "Rhogas 13" (Table I). All foregoing data relative to these parent females is to be had from this table.

To "Rhogas 2," larvæ were exposed on November 15 and 23 respectively. Puparia of offspring parasites appeared from these larvæ November 30 and December 14 respectively, giving 15 days for the egg and larval period (up to formation of puparium) of the parasite in the first case and 21 days in the latter case. Adults emerged December 24 and 29 respectively. Both were males. No male was brought near this female, and therefore these offspring were produced parthenogenetically.

"Rhogas 3," being unmated, was placed in a Doten cage and a host larva put in on November 17. It was immediately stung by parasite and then removed. A parasite appeared from this host larva on December 9, the adult male emerging on December 26. Likewise

this female oviposited in a host larva on December 10, the puparium being formed on December 31, the adult male emerging on January 14, 1915. On December 4, after a male had been placed with this female, but no copulation observed, although the pair was carefully watched, the female oviposited in a larva. The larva was removed to its private cage and the offspring appeared and formed puparium on December 24. The adult emerged on January 9 and was a female.

From "Rhogas 4" were reared five males parthenogenetically.

From "Rhogas 5" were reared five males parthenogenetically.

From "Rhogas 6" were reared four males and one female. Two of these males were reared from eggs deposited in larvæ before placing "Rhogas 6" with a male. After introducing a male into the cage, and noting copulation, this female deposited eggs which resulted in the production of one female and two males.

From "Rhogas 8," unmated, was reared one male parthenogenetically.

From "Rhogas 10," unmated, was reared one male parthenogenetically.

From "Rhogas 11," unmated, were reared two males parthenogenetically.

From "Rhogas 12," unmated, were reared two males parthenogenetically.

A total of 27 successful ovipositions occurred under artificial conditions.

The earlier stages of these for both males and females are similar in duration. The egg and larval period, up to time of formation of the puparium, for both sexes averages 19.1 days. The puparium stage averages 16.7 days, while the length of life of the adult parasites, under artificial conditions, varied remarkably between the two sexes. Males lived on an average 16.5 days, while the females averaged 32.5 days, the longest lived female surviving 75 days: the longest lived male, 35 days.

Temperature played an important part in the development and emergence of adults after the puparium had been formed. A cool period of a few days continuation would apparently interfere with the normal activities and the adult would be delayed in emerging.

It is interesting to note the sex of the offspring of parthenogenetic females as compared to that of offspring of normally mated females. Only males were produced from eggs deposited parthenogenetically. The one apparent exception in the case of "Rhogas 3" being doubtful as to whether or not copulation took place between the female parent and the male to which she was exposed. From mated females, offspring of both sexes were produced. The rule that females alone are

produced from fertilized eggs is still tenable, despite the apparent contradiction in case of number 6, for it is possible that all eggs laid by a pregnant female are not supplied with spermatozoa.

The female Rhogas oviposits, under laboratory conditions, in larvæ of the second and third instar; the parasite puparium is formed when the host larva has reached the fourth or fifth instar.

Conclusions to be drawn from this experiment are as follows:

1. There are probably four complete generations of *Rhogas terminalis* in this region, with a maximum possibility of six generations per year.
2. The parasite hibernates in the puparium stage.
3. The females are nearly twice as long-lived as the males.
4. The parasite is present throughout the entire active season of its host.
5. The parasite oviposits only in second and third instar host larvæ.
6. Eggs are laid within the host.
7. Parthenogenetically, males only are produced.
8. Mated females produce both males and females, the latter, however, are decidedly predominant.

INVESTIGATION AND INSTRUCTION IN BEEKEEPING[1]

By MORLEY PETTIT, *Provincial Apiarist, Guelph, Ontario*

It is the first duty of an investigator and instructor in Apiculture to establish his reason for existence. This was done in the writer's first annual report as Lecturer in Apiculture at the Ontario Agricultural College, published in the annual report of that College for 1909, as follows:

"Beekeeping is one of the most pleasant, healthful, and profitable of rural occupations. . . .

"A large percentage of beekeepers fail from lack of good management. This can be overcome only by education and training. Many a one owes success to early training received in the apiary of an experienced apiarist. Add to this training a scientific college course in the underlying principles of apiculture and you have greatly increased possibilities for success.

"To obtain an intelligent idea of the subject the underlying principles of bee nature must be mastered. Bees are not domesticated in the same sense as farm animals. They are simply wild insects induced to

[1] This and the following three papers were read at a meeting of Instructors and Investigators in Apiculture held at the last annual meeting of the American Association of Economic Entomologists.

dwell near our homes by being provided with conditions most suited to their comfort and prosperity. It has been the purpose of the lecture course to describe these conditions, to give an outline of facts with which every beekeeper must be acquainted."

It is the purpose of beekeeping investigation to determine the principles of bee nature and of instruction to convey them along with methods of their application to the student. From 1909 to the present, it has been the writer's purpose, as yet realized to a very limited extent, to make it "possible to look to the graduating classes of the Ontario Agricultural College, for valuable assistants and foremen of apiaries, trained inspectors of apiaries, queen breeders, lecturers, experimentalists and experts in all lines of beekeeping."

1. Investigations in Apiculture

The problems of investigation proposed in that first report were the following:

Wintering bees; the prevention of swarming; preparation of honey for sale and the marketing of it; the production of commercial beeswax; the control of the mating of queens; the influence of weather conditions on the working of bees and the nectar secretion of flowers; the comb building of bees, including the use they make of comb foundation; the separation of the wax and honey contained in cappings without injury to the honey; the testing of appliances offered for sale by dealers; the testing of queens sold by commercial queen breeders; problems connected with bee diseases.

Most of these problems are as yet almost untouched, owing partly to a lack of equipment, and mostly to the pressure of executive work and teaching. By attention to the well known essentials we are able to winter bees and prevent swarming with more than average success. Successful methods of packing and marketing honey have been investigated and reported on from time to time. Various methods of rendering beeswax from old combs and refuse have been tested. An experiment conducted by C. P. Gillette of Colorado, some years ago, to determine the amount of wax from foundation used in the cell walls in comb building was repeated with similar results to those obtained in Colorado. Various capping melters on the market have been tested to discover some practical method of removing all the honey from the wax without injury to the honey from overheating or contact with the melted wax. During the season of 1915, a honey crop of about 20,000 pounds of honey was extracted in a commercial apiary using the Peterson Capping Melter with good success. This device has a flat surface heated by hot water and slanted to run off the mixture as soon as the wax is partly liquefied. A gravity separator removes the honey quickly from the wax. Queens sold by a number of queen breeders have been

tested coöperatively by different beekeepers in Ontario under the writer's direction. These tests have been made with particular reference to resistance to European Foulbrood. The results have been published by the Ontario Department of Agriculture in a bulletin entitled "Some Results of Coöperative Experiments on Races of Bees to Determine Their Power to Resist European Foulbrood."

"The conclusion reached by the writer with reference to races and strains of bees is that resistance is more a matter of vigor than of race or strain. Results of tests show, however, that common black bees are exceedingly poor resisters, and that Carniolans are not generally as good as Italians. . . . Evidence in favor of leather-colored Italians is perhaps stronger than that for the yellower strains. . . .

"So far as it can be seen by the careful observer who is not a bacteriologist, the disease diminishes in virulence after it has been in a particular locality for a few years. It is also true that the resistance of the bees increases as a result of natural selection or 'survival of the fittest.' On the other hand, apiaries previously Italianized and carefully watched when the disease arrives are not so badly affected."

2. College Instruction in Apiculture

(a) With Long Course Students.

This consists of twenty-five lectures and a few laboratory periods compulsory with all first-year students. The work is based on a text-book,—"Langstroth on the Honey Bee," revised by Dadant. While not entirely fulfilling the writer's ideas of a college text-book, this has perhaps been the best on the market. A change will likely be made to "Beekeeping" by Phillips.

Very little attention is given to the biology of the bee. The teaching of evolution, morphology and physiology, while important, is left largely to the biologist. A brief survey of external anatomy and of the systems of nutrition, respiration and reproduction is sufficient to call attention to the organs and processes of interest to the beekeeper. Enough development is given to explain the life-history of each of the casts. Pathology and hygiene of the apiary are also important.

Our main business, however, is to teach bee psychology, including behavior. On a knowledge, conscious or subconscious, of this, all successful bee management rests. It has usually been acquired by years of experience punctuated by heavy losses. To collect, classify, increase and transmit this knowledge is the task which confronts us. It is not a light one.

It is much easier to describe, for instance, a method of introducing queens than the principles of bee psychology on which all queen introduction must be based. But the student who is not taught these

principles must learn them by the successes and failures of many experiments.

The extent to which the teacher may abstract principles from methods will depend on his own knowledge and on the previous mental training of his class.

It is a very important part of our work to secure a status for the subject in agricultural colleges, and it is gratifying that the deadly indifference if not open ridicule to which it has been subjected in times past is being overcome, although there is room for a great deal of improvement yet.

We consider it a great advantage at the O. A. C. that the subject is compulsory with all first-year students. It gives every student an opportunity to learn something about it. Those who become interested are as far as possible given work in the Apiculture Department, or positions are secured for them with successful beekeepers for the ensuing summer vacation.

In the second year every student of the college has a thesis to write and he may choose a beekeeping subject. Those whose interest continues are given more important work the second vacation, perhaps as inspectors of apiaries. This is continued in the third-year vacation, and they are advised to take the biology option and write their graduation thesis on a beekeeping subject.

So far our efforts to secure a larger place on the curriculum for Apiculture have been without avail, and as there are no elective subjects, except the main divisions called "options" in the graduating year, the difficulty of getting a new subject on the junior years is greater than it is in colleges where electives are common throughout the course.

Two men have already graduated as Apiculture specialists in the Biology Option, and have gone immediately to good positions. The increasing demand for men with this sort of training will doubtless compel our college authorities to give us a proper place at an early date.

b) With Short Course Students.

The Ontario Agricultural College has no general short courses, but has short courses for different subjects such as dairying, poultry, beekeeping, etc. In the Beekeeping Short Course, we aim to cover practically the same ground as with the long course students; the difference being that the lectures are given consecutively six or seven each day for a period of two weeks, and the services of instructors from other colleges, also successful inspectors of apiaries in Ontario, are secured to lighten the labors of the Provincial Apiarist.

Printed programs are prepared and mailed to a large number of beekeepers and others who will be interested. The attendance varies from fifty to one hundred, depending largely on the nature of the previous honey season.

(c) The Students' Apiculture Club meets every two weeks during the term, and is addressed on practical topics by successful beekeepers. Occasionally such prominent men as Dr. Phillips, Dr. Gates, Mr. Dadant or Mr. Root are secured, and their lectures add much to the interest of the club.

(d) Extension Work.

Local short courses have not been undertaken, although they would doubtless be valuable. Bee institutes in winter have been found quite successful in some districts. They give better results than bee lectures at general farmers' institutes. Quite a number of lectures on beekeeping are given at local agricultural short courses held by district representatives. Many of the twenty-six county beekeepers' associations request and receive lecturers at our expense. The most popular form of extension work is the summer apiary demonstration. Of these we held 60 in 1915, with a total attendance of 1,910 persons, an average of 32. Most beekeepers like to be shown as well as told. These demonstrations are arranged and advertised from the office of the Provincial Apiarist. Form post-cards and letters are used, also a list of about 8,000 beekeepers arranged geographically, an addressing machine, stamp affixer, envelope sealer, and whatever other office devices are available.

Demonstration apiaries have been recommended, but so far have not been tried in Ontario. These would be particularly valuable in districts where beekeepers have become discouraged through European Foulbrood. They would need to be managed in series by a man with motor cycle or light motor car.

Demonstrations and educational exhibits at fairs and on Better Farming Special Trains have been conducted to a limited extent. They are valuable in calling public attention to beekeeping, also to the use of honey, but for educating beekeepers themselves, they are not worth nearly so much as the apiary demonstrations.

Not much need be said on correspondence and publications. These are conducted along the usual line. During 1915 about 7,000 letters and reports were received and 5,000 sent out. During the year 43,670 circular letters, report forms, and cards advertising demonstrations were sent out to Ontario beekeepers. We are using the mails to help take the Ontario Agricultural College to the beekeepers of Ontario, and the many kind letters received show that most of them appreciate it very much.

The Apiculture Division of the Experimental Union is really a part of our Extension Work. Early in the year circulars are sent to the complete list of beekeepers offering them a list of experiments, including methods of management and appliances to be tested, also a form on which they can make application for any one of the experi-

ments they wish to test. On receipt of the application properly filled out, the material for the experiment requested is sent, also a form on which the results can be reported. These results are collected at the end of the season, tabulated and summarized for a report.

It will be seen that the educational value to the experimenter who tests some successful method of management under our direction, is even greater than the information gathered from his report, although that has a real value as well.

The Opposition of Beekeepers to Apicultural Education

This is met with to a limited extent from older men, the claims being:

(a) That it will make more beekeepers and crowd the pasturage.

(b) That the increased number of amateur beekeepers will increase the disease menace.

(c) That an increased production of honey will lower the price and reduce the profits.

These objections may be answered as follows:

(a) Vast areas of bee pasturage are at present unoccupied. Any crowding which now occurs is due to the example of successful beekeepers. Instructors should carefully warn against over-stocking.

(b)–Educated amateurs will reduce rather than increase the disease menace.

(c) An increased production with proper distribution and advertising would so develop consumption of honey that it would become a staple with advancing prices. Incidentally education would greatly lower the cost of production.

In Conclusion

It is our business to study bees, their biology, psychology, activities and products, and their relation to climate; also honey flora and nectar secretion and their relation to climate and soils. Incidentally we must study system, efficiency and economics.

It is our business to transmit to the best of our ability the results of these investigations, so that we may have the satisfaction of seeing, if not two bees where one grew before, at least an increase in the sum of enjoyment and profit in this most enjoyable of pursuits.

BEE WORK AT THE CANADIAN GOVERNMENT EXPERIMENTAL FARMS

By F. W. L. Sladen, *Apiarist, Central Experimental Farm, Ottawa*

In the Dominion Department of Agriculture bee culture experiments were started in 1891 under the Division of Entomology and Botany of the Experimental Farms Branch, with two colonies at the Experi-

mental Farm at Brandon, Man. In the autumn of 1893 an experimental apiary was instituted at the Central Experimental Farm at Ottawa, and Mr. John Fixter, who was then farm foreman, was placed in charge of it. In the autumn of 1912 Mr. F. W. L. Sladen was appointed Assistant Entomologist for Apiculture in the Division of Entomology and, when on April 1, 1914, this Division became a separate branch of the Department of Agriculture, the bee experimental work became a separate Division of the Experimental Farms Branch.

The work undertaken by the Bee Division is entirely experimental and consists (1) of experimental work at the Central Farm, Ottawa, and (2) experimental work at the Branch Experimental Farms.

Bees are now kept on thirteen of the Dominion Experimental Farms. Usually the man in charge of the poultry looks after the bees. We find that it is necessary for him to examine the colonies on a certain day every week during the swarming season. It has been demonstrated that bees can be kept profitably at all of these Farms, although at Nappan in Nova Scotia the wintering problem has been found somewhat difficult, both on account of unwholesome stores gathered by the bees and the long winter with its sudden changes in temperature. The principal work is now, therefore, investigating the sources of honey, its quantity, quality and period of production, variation from year to year, etc., the object being to give, eventually, reliable information as to the profitableness of beekeeping for beekeepers who dwell or settle in the regions served by the different Farms, which cover almost the whole of the settled parts of Canada. Hives are kept on scales and the daily weights recorded. When substantial increases in weight are noted, investigations are made in the field to discover the source of the nectar. Samples of the honey are taken from the supers from time to time. It is being recognized that much of this work will have to be done in summer out-apiaries situated at some distance from the Farms, and this development was begun this year on several of the Farms. Some interesting results have already been obtained at some of the Experimental Farms, for instance, alfalfa has proved a valuable source of honey in Southern Alberta.

The best kind of winter and spring protection required to produce good results, and the best methods of spring and summer management and of swarm control at each Farm, are also being experimentally investigated.

The Branch Farm apiaries report to the Central Experimental Farm three times a year—in spring, summer and autumn—on forms in which a number of questions are asked. This year simple forms for a weekly report during the active season when swarming is possible have been started. On these forms are asked the condition of each

colony and what steps have been taken to control swarming, and they are mailed to the Central Farm the day after the weekly examination of the colonies is made.

At the Central Farm the principal problems that are being investigated are swarm control, both by breeding and by manipulation, and wintering, both out-of-doors and in the cellar. Summer out-apiaries are also being established in places where different natural conditions are found such as swamps and sandy plains, so as to investigate the sources of honey there and to ascertain its quality and quantity, and the botanical names of the plants yielding it, and also to investigate the conditions under which they yield. A honey plant herbarium and honey museum are being started. About fifty colonies are kept at the Central Farm, and an average annual crop of between 2,000 and 3,000 pounds of honey has been obtained from it in recent years.

An apicultural building 27 feet by 32 feet with underground basement, containing three bee cellars, is now in course of construction at the Central Experimental Farm, and will, it is expected, be ready for occupation in January. Arrangements are being made to have the temperature, humidity and ventilation in the three bee cellars under artificial control.

One of the functions of the apiaries at the Branch Farms is the supply of bees in observation hives to a large number of fairs to which the Dominion Experimental Farms send exhibits. These observation hives contain one Langstroth frame with brood and honey with the adhering bees and three sections or a shallow frame, containing honey, on top, between sheets of glass.

THE PURPOSE OF COLLEGE BEEKEEPING

By E. F. PHILLIPS, *Bureau of Entomology, Washington, D. C.*

The teaching of beekeeping in agricultural colleges is relatively new. While the work has been sporadically included in such courses for many years, no serious attempt was made to give a constructive balanced course until within the last decade. The increase in this work is highly encouraging but that there are problems to be settled is evident from the desirability of this meeting. It may be assumed that the college authorities do not know definitely what sort of course should be given in so specialized a subject, and it is auspicious that the instructors in this subject have realized the desirability of a conference.

Not being engaged in teaching, I shall not presume to give advice as to the details of the course. It may be an advantage to view the problem from the outside and to look at it from the standpoint of the needs

of the beekeeping industry, from which point of view one has right to suggest.

Little need be said of the malignance of an over-enthusiastic presentation of the possibilities of beekeeping. The booming of the industry is detrimental to those induced to take it up through false representation and it is perhaps even more harmful to the industry and to the institution that permits such a presentation. Beekeeping can readily be painted in too bright colors, even by telling nothing but the truth, but no presentation is honest which does not tell the whole truth. As the demand for beekeeping courses will probably increase more rapidly than the supply of qualified instructors, this is a danger which must possibly soon be faced.

The beekeeping industry needs more of two classes of adherents: 1 the beekeeper who is interested in advancing the scientific phases of bee culture, and (2) the professional honey-producer. There are today more professionals than there are scientific beekeepers but the majority of the professionals are men above middle-age and there are few young men taking up the work. Beekeeping is too strenuous a business to depend on amateurs for its existence for, what with the brood diseases and lean years, the amateur is an unstable factor that does not make for permanence in the industry. It is easier to make professional beekeepers than it is to make scientific beekeepers for two reasons: the training is less exacting and the raw material is more plentiful. The advance of the industry depends chiefly on the work of scientific beekeepers, but its permanence and growth depend on commercial beekeepers. The amateur has little effect on beekeeping except on those who sell the beekeeper's requisites.

There is opposition to the training of more beekeepers. As soon as this is mentioned, overproduction and overstocking are brought forward to overwhelm the suggestion. The industry can be increased ten times before these things become serious for the nectar is available, the consuming public will purchase the products and the nature of the business justifies the increase. We should not neglect our duty because of criticisms due to ungrounded and selfish fear.

If commercial beekeeping should decline it would be useless for agricultural colleges to continue courses in beekeeping. Furthermore, the college authorities are justified in asking for results and unless the departments of beekeeping can produce commercial beekeepers there will be reason to look for a curtailment of funds for the work. A man teaching Greek is not supposed to produce Grecks, but in vocational training tangible results are expected. While some students take beekeeping for use in horticultural work, they add little to beekeeping and could easily get what information they need elsewhere. Their problem would scarcely justify the giving of courses.

It is too much to expect the college teachers of beekeeping to keep up the supply of professional beekeepers, for the relatively few who go to college are not all expecting to make beekeeping their life work. There must be some way of reaching the majority who do not go to college and for this we must try extension work. This is not the phase of beekeeping education that I desire to discuss at this time. But of those who do go to college there are some who are better fitted for beekeeping than for any other work, provided a fair living can be made from the business. Unless this is true, there is no hope for the future of the business. With the increased cost of the necessities of life and our transfer of former luxuries into the class of necessities, beekeeping must be made still more productive or the right type of men will not take it up. Formerly many a beekeeper lived on the products of 100 colonies; few would voluntarily do that today. With a relative decrease in honey prices this becomes still more difficult.

If beekeeping is properly practiced, it will produce an income more than adequate for the average American family. There are many beekeepers who are accomplishing this. If the majority of beekeepers are not making enough from their bees to keep a family of the better class, this may be due either to ignorance of proper methods or inability to do the necessary work. The chief deficiency is a failure to systematize the work. Many beekeepers are loaded down with non-essential details and miss the essentials; in fact most beekeepers fail to systematize their work until they are compelled to do so when they run outyards.

If this is a defect in the practice of the average beekeeper, this may well serve as a clue to the teacher. Beekeeping has been taught for so short a time that the courses are not standardized and it is often a problem what to omit or to include and especially what to emphasize. The beekeeping literature is full of "kinks" and "tricks of the trade" but the work is not well analyzed and systematized in our literature. Small wonder then that the man assigned to give a course in beekeeping often does not know where to begin. Obviously this defect of our literature should be remedied for the sake of the practical beekeeper even more than for the teacher and student.

Every course in a college, whether vocational or strictly cultural, should have cultural value. The educational value of a course devoted to details of practice is very little unless the details are systematized and unless the reason for every step is made clear by a discussion of fundamental principles. A thoroughly practical course that is completely systematized has fully as much cultural value as the courses which are avowedly given for cultural benefits.

The work in a commercial apiary is simple, not complex. It is only the confused beginner who manipulates excessively and does

complex things. If four years is enough for medical training, surely in one year a bright boy ought to be able to learn beekeeping as practiced in commercial apiaries and be able to take care of several hundred colonies. The beekeeping course may not give all the practice needed because of the limited number of colonies usually available, but this can readily be overcome by a summer in a commercial apiary, just as the medical student gets hospital experience. After this extensive beekeeping should be practiced. Of course not all beekeepers manage their apiaries correctly but a beekeeper producing comb-honey in outapiaries is usually not far wrong. With the proper foundation, the student will be able to detect defects in practice. We have all seen men of less than average mental ability who have learned this work, so it is not exceptionally difficult. The old advice to begin with a few colonies and work up slowly is fine for amateurs but does not make professionals.

Are such results being accomplished in the college courses? It may be too soon to demand results but the purpose of the work seems not to be in this direction in all cases. If there is a remedy it lies in a readjustment of the work so that the fundamental principles are learned. Then when it comes to practical work the essentials must be emphasized while the non-essentials and petty details of individual systems of management are ruthlessly cut out.

The teacher of beekeeping will be tempted to give interesting things in the course, as are all teachers. You will be tempted perhaps to overemphasize apparatus because of its availability for laboratory work. You will be frightened perhaps by criticism of present beekeepers against making more beekeepers. However, our industry and your positions depend on results and there is no way to get these except through the elimination of the unfit from the courses and the placing of emphasis on the two big things that the beekeeper does. This does not decrease the interest in the work if properly presented—quite the contrary.

Beekeeping is usually part of the entomological work of the colleges and this is probably the correct relation of the work to the other courses. In the work which we did in entomology there was included considerable morphology and taxonomy. Whether this is the proper emphasis for entomology is not for us to decide, but if one is tempted to follow these lines too closely in beekeeping courses there is reason to question whether the beekeeping course should largely duplicate work which is given in the regular entomological courses. Anatomy is something which makes a good beekeeper a better, broader man but probably it does not make a beekeeper, for behavior is more closely allied to practice than is structure.

Since insect behavior is not an important part of most courses in entomology, there is good reason for giving this phase of bee life more than ordinary emphasis. This is especially desirable in view of the fundamental necessity of such knowledge to the beekeeper. It is far more difficult to outline laboratory work in behavior than in anatomy, but the teacher of beekeeping has the accumulated material from experience and investigation to suggest work of this character. A serious difficulty is that your courses do not all run into the summer, but the winter cluster, the brood diseases, the development and care of the brood, wax secretion, effects of accumulated feces, responses to changes in temperature, light and humidity are all readily studied even in mid-winter. Since the wintering problem is the most serious one which confronts the beekeeper you are justified in giving this much attention. The greatest possible amount of manipulation of bees should be provided, even though you sacrifice colonies for this purpose. Then one or two periods may profitably be devoted to the study of apparatus and by the time these things are covered it will usually be time for outdoor work, assuming that the course begins in mid-winter.

It may reasonably be assumed that my suggestions are instigated by a feeling that all the beekeeping courses are not up to the standard that I would set. While I have not had experience in teaching beekeeping, I nevertheless feel that by coöperation the present defects may be remedied. Several rather surprising experiences with former students of beekeeping in various sections of the country have induced me to say what I have said, but I prefer that my criticisms be taken as general, not specific. I trust that this first conference will be a step toward correcting deficiencies.

THE BEEKEEPING WORK IN MASSACHUSETTS[1]

By Burton N. Gates, *Associate Professor of Beekeeping, Massachusetts Agricultural College, Amherst*

1. Investigation, under the Massachusetts Agricultural College Experiment Station.

Experiments and investigation, theoretical and practical, are being carried on concerning bee diseases, color vision of bees, wintering and beeswax, together with minor investigations in other lines.

2. College Instruction

Two courses are offered regularly enrolled, four-year students.

Entomology 8, Beekeeping, two lectures and one laboratory weekly during the second semester. Elective, primarily for juniors but open to seniors. A text-book has not been assigned.

[1] Virtually an outline of the paper as presented.

Entomology 10, Beekeeping. A course more advanced than the previous one, designed primarily for seniors, but juniors may elect it. One lecture and one laboratory weekly during the second semester. This is virtually a seminar, hence no one text-book is used.

For students of the Ten-Weeks' Winter School. Two lectures and one laboratory period weekly.

3. Extension Work

The Extension work in beekeeping has not been definitely provided for. It includes:

An Itinerant School, meeting once in three years at Amherst, otherwise at various points in Massachusetts. When at Amherst the school is of two weeks' duration, and has a staff of four to seven lecturers and demonstrators. Time devoted, a full day for five days each week. Excursions and special demonstrations are arranged for Saturdays.

Summer School. Ten lectures and laboratory practices are offered each year during summer school.

Correspondence Course. A correspondence course is provided those who may elect it. Twelve lessons are offered, based on Mrs. Comstock's "How to Keep Bees."

Annually, during Farmers' Week, a three days' convention is provided.

The College maintains an elaborate equipment which is displayed under a large tent, at a limited number of agricultural fairs each season. It is probable that this equipment will include jointly an apicultural display from the State Board of Agriculture.

4. State Board of Agriculture

The inspection work of the state is carried on by three deputy inspectors and one chief under the direction of the State Board of Agriculture. Also, the majority of the lectures and demonstrations at the meetings of the beekeepers' societies and at their field days, are paid for from the funds of this Board. However the expenses of some grange and other lectures are borne by the institution before which they are given. The State Board of Agriculture has a series of publications, now numbering ten, designated "Apiary Series." Emergency and other demonstrations are held under the provisions of the Apiary Inspection Act.

5. Other Work

The Beekeeping Department of the College maintains a wax rendering station and has handled enormous quantities of raw material for the beekeepers of the locality. This has proven a pleasing feature of the apicultural service of the state.

It is the plan and purpose in directing the apicultural work of the state to unify or centralize it and in so far as possible to correlate it. Thus the College and State Board of Agriculture join in certain features of the work. This is desirable from the standpoint of eliminating duplication.

THE COLUMBINE LEAF-MINER[1]

By E. N. Cory, *College Park, Md.*

Historical

This insect was first described by Hardy in the *Annals and Magazine of Natural History*, Vol. 4, p. 385, 1849 (Second Series, No. 24), under the title "XL, on the Primrose leaf miner; with notice of a proposed new genus and characters of three species of Diptera, by Mr. James Hardy."

In this paper Mr. Hardy separates Phytomyza from Chromatomyia on the basis of the shape of the pupa and the place of pupation, the latter pupating in the leaf.

It is of interest to note that considerable credence was placed on the myth, that the coming of a flying serpent was forecast by the presence of the tracery of the leaf-miner on the leaves. In the words of Hardy: "A flying serpent will poison the air, which becoming impure will cause the death of 19 out of 20 (people); and that the time will be known by this particular appearance on the leaves, which the pseudo prophet calls the reflection of the serpent."

Hardy records the insect as appearing first August 13. Very little biological data of value is recorded.

Kaltenbach records the insect in "Die Pflanzenfeinde aus der Klasse der Insekten" 1872, p. 13, placing *Phyt. albiceps* Meig., *minuscula* Gour. and *ancholiæ* Rob.-Des. in synonymy. He states that the larvæ begin to work in June following a winding course, ending in an enlarged spot and finally end their wanderings at the time of frost in the earth.

In this country Dr. W. E. Britton, State Entomologist of Connecticut, was the first to record its presence, p. 145, Report of the Connecticut Agricultural Experiment Station, 1894.

In this account Dr. Britton described the larva as a footless grub 1-16 inch in length feeding in the parenchymatous tissues. The method of pupation, in the last larval skin, attached to the leaf is stated. Several broods are suggested, since the work of the insect was observed from June 26 to frost. Destruction of the infested leaves is suggested

[1] Contribution from the Maryland Agricultural Experiment Station.

as a control measure. The insect was found in *Aquilegia canadensis*. Two excellent figures of the work of the larva in the leaves are shown.

The substance of this article was published by Dr. Britton in *Garden and Forest*, Vol. VIII, 1895, p. 443, Fig. 61. In this article the insect was noted from the middle of May to October 11.

A brief note of the presence of the insect at Inwood, New Brunswick, N. J., was published by S. Van R. Strong, *Garden and Forest*, Vol. X, 1897, p. 278.[1]

Aldrich's Catalog of North American Diptera, under *Phytomyza aquilegiæ* Hardy, notes the original description by Hardy cited above; larva mines the leaves of *Aquilegia vulgaris;* also Coquillett Bul. 10 N. Ser. Div. 78, giving its distribution as D. C., Conn.; larva mines in nasturtium and columbine.

Coquillett's article published in 1898 records rearing eight adults from nasturtium, October 1884, others were reared July 1897, and he cites the rearing by Britton, 1894, who submitted his specimens to Mr. Coquillett for determination. Coquillett stated that *Phytomyza ancholiæ* Rob. Des., placed in synonymy by Kaltenbach, is also a pest of Aquilegias.

Melander, "Synopsis of the Dipterous Groups Agromyzinæ, Milichiinæ, Ochthiphilinæ and Geomyzinæ," *Jour. N. Y. Ent. Soc.*, Vol. XXI, No. 3, p. 271, records specimens from Illinois and Idaho in addition to the other places recorded in this paper.

Habit of the Larva

The columbine leaf-miner was first noticed in the larval stage on May 11, 1914, at the Maryland Experiment Station. These larvæ pupated three days later. In view of our present knowledge of the life-history, the eggs must have been deposited on or about the first of May.

The infestation was light but later spread to practically every plant at the Experiment Station in three widely separated localities.

The lower leaves are the first to be attacked, the first and second generations confining their attentions almost entirely to them. Later the small leaves around the flower stalks may become infested.

The larval mine gradually widens out from the beginning taking a serpentine course, frequently crossing upon itself and ending in a spot nearly $\frac{1}{8}$-inch in width. The mines are plainly visible on the upper surface as white lines but can be seen only by transmitted light in examining the lower surface.

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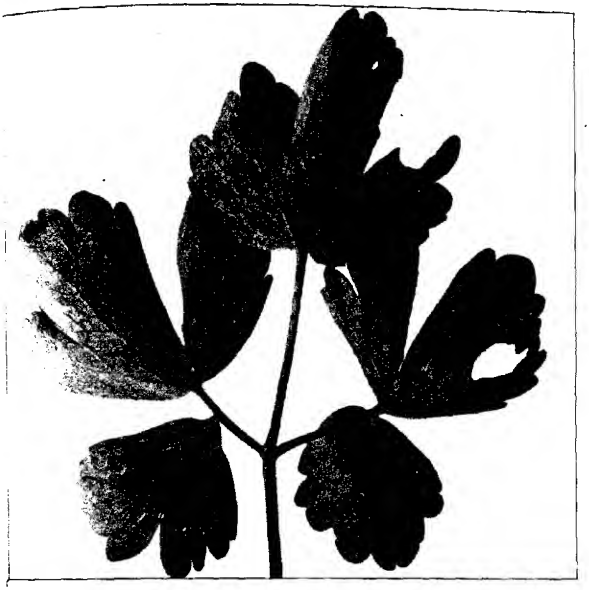
[1] The author is greatly indebted to Dr. Britton for transcriptions of the two articles in *Garden and Forest*.



Pupæ on under side of columbine leaf.

Badly infested columbine.

Usually not more than eight to ten larvæ can be found in the three lobes of a leaf though in plants under breeding jars, as high as thirty-three larvae have succeeded in reaching the pupal stage in a single leaf.

General Statement of Seasonal History

Phytomyza aquilegiæ Hardy hibernates in the pupal stage, the first adults appearing during the last of April and the first of May. These deposit eggs about the first of May. These eggs require nearly twice as long for their development as those of succeeding generations. The second generation appears about the 25th of May, completing its life cycle about one month later. From the beginning of the second generation the broods overlap considerably, but a third generation develops about the last of June. From that time on through July and August the parasites are numerous and it is extremely difficult to find any unparasitized larvæ. Moreover, it appears that during this time the adults cease to deposit as no new mines have been found during this time. The lack of infestation during the last of July and August may be due to the fact that very few new leaves are produced by the plants at this station after July 15, until the middle of September. However, a fourth generation appears about the middle of September and winters in the pupal stage.

The Egg

The egg is oblong-oval; slightly larger at one end. It is translucent pale greenish white, sub-glossy and bears no surface markings. Length 123. x 235. microns.

The eggs are deposited in the under side of the leaves with the point sometimes directed almost at 90 degrees to the leaf surface and again they may be pushed into the tissues so far that they lie parallel with the leaf surfaces (Fig. 25*a*).

Before copulation or oviposition, the females feed, puncturing the leaves with their ovipositors in hundreds of places. The ovipositor is inserted on the upper side of the leaf and the body twisted on the ovipositor as an axis until the opening is quite large. The adult then backs away from the incision until the head comes over the opening, when she feeds on the exuding liquid.

After feeding for a time the adults copulate for a period of 40 to 50 minutes. Sometimes a female copulates a second time. They begin egg-laying very soon thereafter.

The Larva

The first stage larva is about 650 to 750 microns long when newly hatched. It is translucent and nearly hyaline, though showing some yellow bodies, apparently fat cells. The light brown chitinous mouth-

part or "rake" is prominent (Fig. 25*b*). The second day shows an increase in size to 830 microns, the color remaining practically the same except that some of the yellow bodies have disappeared. The size increases gradually until a point is reached when the larva attains a

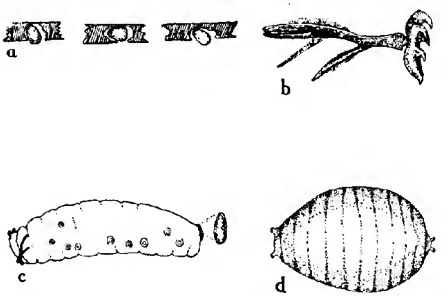


Fig. 25. Columbine leaf-miner: *a*, eggs; *b*, mouthparts or "rake"; *c*, larva; *d*, pupa.

length of 1650 microns. The full grown larva is translucent, greenish when chlorophyl is present in the alimentary tract, hyaline at other times; segmentation is not distinct. The chitinous mouthparts are dark brown to black and the tips of the spiracles light brown. There are two erect spiracles on the anterior segment and two larger widely divergent spiracles on the posterior segment. The spiracular opening presents from above, a double rosette appearance (Fig. 25*c*).

The Puparium

The puparium is nearly oval in outline viewed from the dorsal aspect. Viewed from the side, the dorsal surface presents a considerable convexity, reaching its highest point at the middle segment. Ventral surface only slightly convex. Length 1250 to 1500 microns. The anterior and posterior spiracles are at the extremities of short pedicles. Segmentation distinct (Fig. 25*d*).

The Adult

It has been thought best to draw up a revision of the original description by Hardy, since that is in a publication not generally accessible and the description is written in Latin. The present description varies only slightly from that of Hardy, particularly in regard to the color of the proboscis, which he refers to as white and the wings which he describes as hyaline.

General color dark brown to black, especially on the dorsum. Length: from tip of arista to tip of wing 2.85 mm.; from tip of arista to tip of abdomen 1.75 mm. Front yellow around ocelli, shading to black at base of antennæ. Two proclinate ocellar bristles, three orbital bristles, two pairs of verticals; oral vibrissæ short and

stout; two pairs of dorsocentrals; disc sparsely setose, two erect scutellar bristles. Abdomen setose on lateral margins. Front concave, proboscis light yellow, palpi inconspicuous, black and globular. Cheeks light brown, mesonotum shining black, pleural sutures outlined with light yellow. Wings iridescent, base of veins light yellow to white, halteres light yellow to white. Abdomen black, legs brown, yellowish at joints. Venation as in Fig. 26. Ovipositor, brown.

Fig. 26. Columbine leaf-miner, wing.

The Period of Incubation

The length of time required for hatching of the egg varies with the different generations. Probably the temperature is the determining factor. Eggs of the first generation require an average of 5½ days. Eggs of the second, third and fourth generations average 2 days. Averages for the year are of no value.

Length of Larval Stage

The length of larval stage seems to be less dependent on temperature than the egg stage. This is shown by the fact that the longest larval period observed in May was 11 days while in June, 12 days was the longest, with an average for the two months, however, of 10.5 days, the same as the average for May. The principal limiting factor is a reduction of the food supply such as occurs when too many eggs have been deposited in a given leaf. Under such circumstances the length of the larval period may be reduced to six days. The normal average for all generations is 10.5 days.

The Pupal Stage

The larva emerges from a crescent-shaped cut on the under side of the leaf, remaining attached thereto. In only two instances have larvæ been noticed pupating on the upper surface of the leaf. The pupal stage of the first and second generations occupy an average of 14 days. The third generation may take 19 days for the pupal stage, or, there may be a period of æstivation lasting from the first week in June to the second week in September. The fourth generation winters over as pupæ on and in the ground and the compost at the base of the plants.

Puparia, sifted from the first half inch of soil beneath plants on March 3, gave adults and parasites on April 9, in the insectary. The first individuals appeared out of doors on April 22.

Parasites

Thirteen species of parasites have been reared from the columbine leaf-miner.[1] As mentioned before, they exert a decided influence at

[1] The author is greatly indebted to Mr. A. B. Gahan for the determination of the parasites.

certain times during the year but are not able to cope with the first brood.

The parasites reared in greatest abundance were species of Closterocerus, especially *C. tricinctus* Ashm. Next in point of number was *Closterocerus utahensis* Gahan. Nine specimens of *Sympiesis agromyzæ* Gahan, nine specimens of *Diaulinus pulchripes* Crawford, seven specimens of *Diaulinus begini* Ashm., three specimens of *Derostenus varipes* Crawford, two specimens of *Derostenus pictipes* Crawford, and several specimens of *Zagrammosoma multilineata* Ashm. were reared. In addition one Pleurotropis sp., one Aphæreta sp., one Mymarid, four Chrysocharis, probably *C. parksi* Crawford and one Derostenus n. sp. were reared.

Control

Cultivation about the plants at any time after pupation of the last generation and before April 1 will undoubtedly reduce the chance of infestation. In one case, a flower bed at this Station was spaded over in early March before freezing weather was over. The columbines in this bed were entirely free from infestation by the first brood, though the previous year the infestation had been very severe. About 100 feet from this bed another plot of columbines left uncultivated until May were badly infested by the first generation. Removal and destruction of infested leaves in May before the infestation becomes general should control the depredations of the insect. No other food plants have been found though the nasturtium is recorded as a host by Coquillett. Repeated efforts to breed adults from mines in this plant have resulted in failure. The common miner of nasturtium here appears to be another species.

NOTES ON THE HABITS OF A DANGEROUS GENUS OF WEEVILS

By W. Dwight Pierce, *Bureau of Entomology, U. S. Department of Agriculture*

Recently two species of European weevils belonging to the genus Polydrusus have been found in the United States. Four other species are apparently native or have been long established. This genus is composed of very destructive species in Europe and one of the imported species is already doing considerable damage in New York and Connecticut.

Because of the possibility of further importations in nursery stock the writer has gathered together the following notes on the habits of the various species of the genus and drawn up descriptions of the stages of one of the introduced species.

Genus Polydrusus Germar

This genus was described by Germar in 1817 (*Mag. der. Ent.*, Vol. 2, pp. 339-341) and has for its type, *undatus* Fabricius, designated by Schönherr in 1826. Schönherr at this time (*Curc. Disp. Meth.*) emended the name to *Polydrosus*. LeConte and Horn in 1876 described the genus *Cyphomimus* (*Proc. Amer. Philos. Soc.*, Vol. 15, p. 105) with the type *C. dorsalis* Horn, which genus in the present conception of *Polydrusus* can only be accepted as a subgenus. The genus belongs to the Family Brachyrhinidæ Bedel, Subfamily Psallidiinæ Pierce. Tribe Polydrusini Pierce. In Europe it is subdivided into quite a number of subgenera which may ultimately be raised to generic rank if the habits of the species warrant it. Our American species have not been critically studied with a view to correlating them with the European classification.

Four species are apparently native of this country or have been long established. Two species have been recently introduced and one of these is very injurious.

Polydrusus (Eustolus) impressifrons Gyllenhal

Imported Poplar Root Weevil

This species is found in Europe on willow, especially *Salix viminalis* L., alder and hazelnut, and its variety *flavovirens* Gyllenhal is recorded from aspen (*Populus tremula*) and other trees of the genus Populus.

According to Mr. P. J. Parrott, who is making an exhaustive study of the habits of this weevil in New York:

> The beetle appears during the latter part of May and begins to oviposit immediately. The eggs are white in color and cylindrical in form. They are placed under loose bark, such as appears on the ends of broken branches or on stubs as the result of poor pruning, or in depressions or in wounded branches and trunks covered by projecting bark or even among loose bud scales of dead wood. The eggs are deposited in irregular masses containing from twenty to eighty to an assemblage. Oviposition is most active during June. The newly hatched larvæ drop to the ground and subsist on roots. They are known definitely to feed at the roots of willow, poplar and birch. Pupation takes place during early May of the following year. The beetles seem to be partial to willow, poplar and birch, but they feed on other plants among which may be listed apple and pear. Applications of arsenicals at first appearance of beetles affords efficient protection against the weevils.

The adult beetle is covered with beautiful blue-green scales. The legs are reddish. The form is brought out very clearly in Mr. Bradford's drawing.

In order to separate this species from another recent importation the following translation of the original description is given.

Polydrusus impressifrons Gyllenhal. Schönherr's Gen. et Sp. Curc., Vol. 2, p. 140.

> Oblong, black, fuscous pubescent, densely clad above and beneath with green scales; antennæ and legs pallid testaceous; rostrum very short; frons impressed; femora mutic; antennal scape reaching behind eyes; funicular joints 3-7 obconical.

Similar to *P. flavipes*, but smaller, pubescence shorter and frons more flattened, subimpressed. Head rather large, subquadrate, punctulate, black, densely squamose with green scales; frons between eyes lightly impressed, with deep median puncture; eyes small, semiglobose, brown; rostrum narrower than head and half as long, similarly squamose. Antennæ slender, pallid testaceous, hardly surpassing the base of the thorax. Thorax small, transverse, basally and apically truncate, somewhat rounded at sides, lightly convex on dorsum, lightly transversely impressed near base

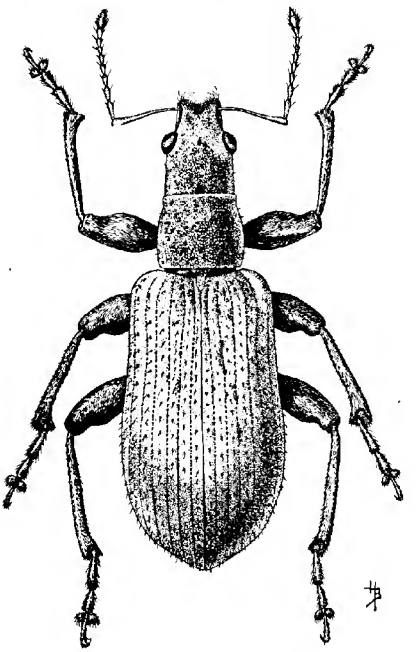


Fig. 27. Poplar root weevil, *Polydrusus impressifrons* Gyll.

and apex, punctulate, black, densely clad with green scales. Scutellum triangular, squamose. Elytra at base one-half wider than thorax; humeri elevated, almost rectangular; apices conjointly acuminate; six times as long as thorax, convex, subtly punctate-striate, interspaces broad, flat; black, covered with green scales mixed with short fuscous pubescence; interspaces sparsely and finely punctate. Body beneath punctulate, black, densely squamose. Legs rather short, pallid testaceous, cinereo-pubescent; claws brown.

Variety β. Color of scales more splendid, flavo-virescent.

Variety γ. Color of scales coeruleo-virescent.

Very careful drawings of the immature forms have been made by the writer, to aid in the field identification of the species. These are based on specimens furnished by Mr. Parrott.

Larva.—Creamy white with head slightly yellowish, but very little darker than the body. Mandibles and edge of frons darker. Length 4–6 mm. Body bristling with long setæ.

Head deeply, triangulately, emarginate at middle. Mandibles bluntly two-toothed. Margin between labrum and clypeus (post-labrum Lyonet 1762) faint. Antennæ minute, ovoid. Maxillary palpi minute, two-jointed. Labium broad obtuse, rounded at sides, terminated by a thin chitinous bow at base of stipes labii, palpi two-jointed, small, terminated by long setæ. Frons triangular, with one pair of long, very fine setæ. Epicranium with three pair of fine setæ along frontal suture and with two posterior setæ. Thorax and abdomen provided with many long setæ. Spiracles indistinct. The last segment is almost circular with the anal opening in the center and this is placed slightly in front of the apex of the abdomen. The next to the last segment has four long distant dorsal setæ and four approximate finer ventral setæ.

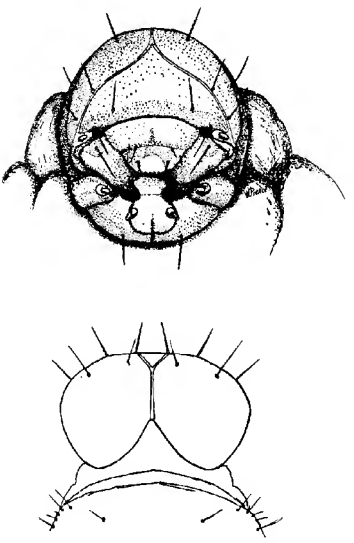


Fig. 28. *Polydrusus impressifrons* Gyll. Face of larva and dorsal aspect of larval head.

Fig. 29. *Polydrusus impressifrons* Gyll. Side view of larval head and ventral aspect of apex of abdomen.

Pupa. The pupa is characterized especially by the broad two-pronged apical segment.

Color creamy-white, eyes black. Length 4.5 to 5 mm., breadth 1.25 mm. Dorsally and laterally sparsely bristling with setigerous tubercles. Beak short, robust, enlarged at mandibles, near median line with three pair of setæ. Eyes placed closer together than width of beak. Between and above each eye are four setæ

arranged in a curve equidistant from the eye. The head is also provided with one pair of distant setæ on vertex. Antennæ geniculate, clavate and quite long. The thorax is dorsally characterized with a pair of lateral very prominent setigerous tubercles. On the front margin between these tubercles are two pair of small setæ. A very fine hair also arises at the base of each large tubercle. About the middle are two distant setigerous tubercles which form with two sublateral tubercles a semi-circle. Mesothorax between the elytra provided with two setigerous tubercles. Metathorax also provided with a pair of tubercles which are farther apart than those on the mesothorax. First seven abdominal segments with three pair of dorsal setigerous tubercles on each segment, arranged so that they make six longitudinal series of tubercles. In addition to these dorsal tubercles, each segment is provided laterally with several tubercles. Eighth dorsal segment with only four tubercles. The ninth segment is the apical segment dorsally. This is provided at its outer corners with two long inward curving processes which are semi-acute at apex. Ventrally the body is not provided with tubercles nor setæ except near the base of the sides of the ninth segment. At these places are to be found the longest setæ of the body. The arrangement of the ventral folds of the last segments is better described by means of the accompanying illustration, than can be stated in words. Each femur is apically armed with three setæ.

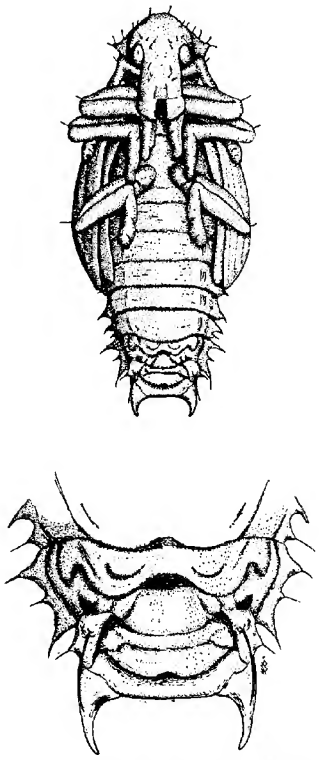


Fig. 30. Ventral view of pupa of *Polydrusus impressifrons* Gyll., with enlargement of posterior extremity.

Polydrusus (Thomsoneonymus) sericeus Schaller

Imported Fruit Bud Weevil

This weevil is one of most recently discovered importations. Two specimens have been examined which were collected in Marion Co., Indiana. In Italy this species is quite injurious as an adult to the buds and foliage of fruit trees, especially the pear, and is also found on plum, hawthorn (*Cratægus oxyacantha*), beech, and dogwood (*Cornus*

mas). In Saxony it is common on willow (Bargagli,[1] p. 59); in France on hazelnut, oak and willow (Bedel,[2] p. 242); also on alder, hazelnut, plum (*Prunus spinosa* L.), apple and beet (Kleine,[3] p. 104).

The species is slender, and beautifully covered with green scales. It very closely resembles *impressifrons*.

A technical description translated from Fahræus, follows:

Polydrusus sericeus Schaller. Acta Hal., Vol. 1, p. 286; Gyllenhal, Schönherr's Gen. et Sp. Curc., Vol. 2, pp. 148, 149; Fahræus, Schönherr's Gen. et Sp. Curc., Vol. 6, pt. 1, p. 450.

Oblong, black; clad with rounded opaque green scales; antennæ and legs pallid testaceous; beak longer, frons lightly canaliculate; elytra moderately punctate striate, interspaces flat; scape of antennæ attaining but not passing eyes, funicular joints 3-7 obconical.

The Habits of Other Species in the Genera

The records presented herewith are all that can be found concerning the habits of these destructive weevils.

The notes indicate that they lay the eggs in masses, that the larvæ seek their food, and that they feed on roots and pupate in the ground. The only exception is *cervinus*, reported to breed in leaf rolls.

Polydrusus delicatulus Horn occurs in lower California.

Polydrusus peninsularis Horn also occurs in lower California.

Polydrusus corsicus Tournier of Corsica feeds as an adult on the buds in various plants, especially the oaks (*Quercus ilex* and *Q. suber*).

Polydrusus viridicollis Baudi does considerable damage at times to the foliage and epidermis of new growth of ash (*Fraxinus*), *Cytisus*, the oak (*Quercus cerris*) and maple (*Acer*). The adults drop when disturbed (Bargagli, p. 60).

Subgenus Cyphomimus Horn

Polydrusus (*Cyphomimus*) *americanus* Gyllenhal (*dorsalis* Horn) has been beaten from budding oak by Popenoe, found on the plum (*Prunus virginica*) by Jülich, and collected on many bushes by Hamilton. Occurs in Ontario, New York, West Virginia, Maryland, Ohio, Michigan, and Kansas.

Polydrusus (*Cyphomimus*) *ochreus* Fall is common on scrub oak at Cloudcroft, New Mexico.[4]

Subgenus Chærodrys Duval

Polydrusus (*Chærodrys*) *setifrons* J. Duval of Europe lives on oak (*Quercus ilex*) Bargagli, p. 59).

Polydrusus (? *Chærodrys*) *moricei* Pic of Europe was taken on young shoots of oak.[5]

Subgenus Metallites Germar

The insects of this subgenus live on Rosaceæ and Amentaceæ, particularly *Quercus* and *Betula*, and some of them on Conifers.

Polydrusus (*Metallites*) *impar* Gozis (*mollis* Germar) of Europe feeds as an adult on the young foliage of oak (*Quercus suber* L.), pines (*Pinus silvestris* L., *P. pinea*),

[1] Bargagli, P., Rassegna Biologica Rincofori Europei, 1883-8.
[2] Bedel, Faune Basin Seine, 1888.
[3] Kleine, Ent. Blätter, 1910.
[4] Cockerell and Fall, Trans. Am. Ent. Soc., Vol. 33, 1907, p. 212.
[5] Pic, L'Echange, 1903, Vol. 19, p. 123.

and fir (Bargagli, p. 56); spruce (*Picea excelsa* Lam.), larch (*Larix europæa* L.), the fir (*Abies pectinata* D.-C.), and the oak (*Quercus pedunculata* Ehrh.) (Kleine, p. 103).

Polydrusus (*Metallites*) *atomarius* Olivier (*laricis* Chevrolat) of Europe feeds as an adult on the leaves and buds of larch, pine and fir (Bargagli, p. 56); *Pinus silvestris* L., spruce (*Picea excelsa* Lam.), fir (*Abies pectinata* D.-C.), beech (*Fagus*), hornbeam (*Carpinus*), oak, and willow (*Salix viminalis* L.) (Kleine, p. 102).

Polydrusus (*Metallites*) *marginatus* Stephens (*iris* Olivier) of Europe is believed to breed in the dead roots of cedar (*Juniperus communis* L.). The adults feed on the foliage and buds of the oaks (*Quercus robur pedunculata* Ehrh., *G. robur sessiliflora* Sal., *Q. cerris* L., and *Q. ilex* L.), birch (*Betula*), cedar, beech, *Erica arborea*, *Calluna vulgaris*, alder (*Alnus*) and hazelnut (*Corylus*) (Bargagli, p. 56); and pine (*Pinus silvestris* L.) (Kleine).

Polydrusus (*Metallites*) *parallelus* Chevrolat has been found in Sardinia on the buds of *Atriplex* (Bargagli, p. 56).

Polydrusus (*Metallites*) *elegantulus* Boheman (*pistaceæ* Kiesenwetter) in Greece is found on *Pistacia lentiscus* (Bargagli, p. 57).

Polydrusus (*Metallites*) *pirazzolii* Stierlin in Italy is found in May and June on oak and hornbeam (Bargagli, p. 57).

Subgenus PIEZOCNEMUS Chevrolat

Polydrusus (*Piezocnemus*) *chaerodrysius* Gredler of Europe lives on pine (Bargagli, p. 58).

Subgenus CHLORODROSUS Daniel

Polydrusus (*Chlorodrosus*) *abeillei* Desbrochers in France lives on *Pyrus torminalis* (Bargagli, p. 57).

Polydrusus (*Chlorodrosus*) *amœnus* Germar occurs on blackberry (*Rubus vitisidæa* L.) (Kleine, p. 104); *R. idæus*, gooseberry (*Ribes*), and mountain ash (*Sorbus aucuparia*) (Schaufuss,[1] p. 1056).

Subgenus EUDIPNUS Thomson

Polydrusus (*Eudipnus*) *mollis* Ström (*micans* Fabricius) of Europe breeds in the ground and the adults feed on the foliage of beech (Bargagli, p. 58); hornbeam, hazelnut, beech, and willow (Bedel, p. 241); pine (*Pinus cembra* L.), birch, oak (*Quercus pedunculata* Ehrh.), and apple (Kleine, p. 102).

Polydrusus (*Eudipnus*) *coccifcræ* Kiesenwetter and its variety *creticus* Kiesenwetter lives in Greece and Crete on *Quercus coccifera* (Bargagli, p. 49).

Subgenus THOMSONEONYMUS Desbrochers

Polydrusus (*Thomsoneonymus*) *lateralis* Gyllenhal of Europe has been taken in June on beech (Bargagli).

Subgenus EUSTOLUS Thomson

Polydrusus (*Eustolus*) *flavipes* DeGeer of Europe feeds as adult on tender foliage of *Geum urbanum*, and alder (Bargagli, p. 58); alder (*Alnus glutinosa* Gaertn., and *A. incana* D.-C.) and hazelnut (Kleine, p. 103).

Polydrusus (*Eustolus*) *chrysomela* Olivier in Austria is found on young beech (Bargagli, p. 58); in France on maritime Chenopodiaceæ (Bedel, p. 243); on birch (Kleine, p. 103).

Polydrusus (*Eustolus*) *confluens* Stephens occurs on various Genisteæ (*Sarothamnus*, *Genista*, *Ulex*) (Bedel, p. 242); *Ulex europæus* L., and *Genista sagittalis* (Kleine, p. 103).

Polydrusus (*Eustolus*) *cervinus* Linnæus of Europe is found in May and June on young branches of oak and birch, and is also found on beech (Bargagli, p. 57); on oak and hazel (Bedel, p. 242). The larvæ breed in leaf rolls in terminals sprigs on

[1]Schaufuss, C. Calwer's Käferbuch, 1914.

birch (*Betula alba* L.) and oak; also occurs on hornbeam, hazel and larch (*Larix europea* L.) (Kleine, p. 104).

Polydrusus (*Eustolus*) *cervinus melanostictus* Chevrolat is said by Bouché to breed in August in the tips of oak branches where it cuts the leaves to form an involucre. This record is questioned by other authors (Bargagli, p. 57).

Polydrusus (*Eustolus*) *pilosus* Gredler (*melanostictus* Chevrolat) of Europe occurs on hornbeam (Bargagli, p. 58); on spruce (*Picea excelsa* Lam.) (Kleine, p. 103); on birch and beech (Schaufuss, p. 1057).

Polydrusus (*Eustolus*) *griseomaculatus* Desbrochers in France lives on beech Bargagli, p. 58).

Polydrusus (*Eustolus*) *rubi* Stierlin occurs on *Rubus idaeus* L. (Kleine, p. 103).

Subgenus POLYDRUSUS Germar

Polydrusus pilosulus Chevrolat (*mollis* Boheman, *villosulus* Chevrolat) of Europe feeds on the young foliage of oak and *Pinus pinea* (Bargagli, pp. 58, 60).

Polydrusus leucaspis Boheman (*suturellus* Chevrolat) in Corsica is found on elm Bargagli, p. 58).

Polydrusus tereticollis DeGeer (*undata* Fabricius) of Europe feeds on the foliage of alder, pine, birch, hazelnut, and hornbeam (Bargagli, p. 59); also on beech, oaks *Quercus pedunculata* Ehrh., and *Q. sessiliflora* Lam.), fir (*Picea excelsa*) and pine *Pinus silvestris*).

Polydrusus ruficornis Bonsdorff (*intermedius* Zetterstedt) of Europe feeds on the foliage of birch and pine (*Pinus silvestris*) in July and August (Bargagli, p. 58); on hazel (Kleine, p. 104).

Polydrusus picus Fabricius in Germany is found on young beech (Bargagli, p. 59).

Polydrusus sparsus Gyllenhal is found on oak in Germany, on alder (*Alnus glutinosa*) in Corsica, and on *Rubus* in Italy, and has been taken hibernating under bark of *Platanus orientalis* (Bargagli, p. 59).

Polydrusus prasinus Olivier (*planifrons* Gyllenhal) of Europe feeds on foliage of birch, *Urtica* and alder (*Alnus incana*) (Bargagli, p. 59); and on oak (Bedel, p. 243).

Polydrusus brevicollis Desbrochers in Italy is found on plum (*Prunus spinosa*) Bargagli, p. 57).

Polydrusus villosulus Chevrolat is rarely found in Spain in a forest of *Pinus pinea* (Bargagli, p. 60).

Subgenus TYLODRUSUS Stierlin

Polydrusus (*Tylodrusus*) *pterygomalis* Boheman (*pterygomaticus* Boheman) of Europe is found on hawthorn, willow and cherry (Bedel, p. 244); on birch, hazelnut and beech (Kleine, p. 104).

Polydrusus (*Tylodrusus*) *coruscus* Germar of Europe is found on willow (Bedel, p. 244) and on birch (Schaufuss, p. 1057).

NOTES ON ANASA ANDRESII GUÉR., AN ENEMY OF CUCURBITS[1]

By THOS. H. JONES, *Entomological Assistant, Truck Crop and Stored Product Insect Investigations, Bureau of Entomology, United States Department of Agriculture*

Two species of the heteropterous genus Anasa have already attracted the attention of economic entomologists. These species, *tristis* DeG. and *armigera* Say., are both known enemies of cultivated

[1] Published by permission of the Secretary of Agriculture.

cucurbits in the United States, *tristis* being the more important pest. During 1915 the various stages of a third species, *Anasa andresii* Guér., were present on squash at Baton Rouge, Louisiana. The damage, while not especially severe, was sufficient to warrant a study of the life-history and habits of the species, especially since there appears to be no reference to it in the literature of economic entomology.

The following preliminary notes have been compiled from observations made during 1915 by the writer and by Mr. C. E. Smith, who has assisted in the studies concerning the life history.

Distribution of the Species

Anasa andresii was first described as *Coreus andresii* by Guérin-Meneville in 1856 from Cuba.[1] It is also known to be present in Mexico, Guatemala, Costa Rica, Panama and Colombia, and in the United States it has been reported from Florida, Texas, and New Mexico.

Description of the Stages

Egg.—When fully colored it is dull, reddish brown, the surface divided into minute hexagonal areas which, on all except the lower surface, have shallow depressions at their centers, and which are not found on the eggs of *tristis* or *armigera*. On the lower surface, in the central portion of which there is a slightly raised area or "button" by which the egg is attached to the surface upon which it is deposited, these depressions are lacking and the surface is smooth.

Five eggs gave an average length of 1.45 mm., an average width of 0.97 mm., and an average height of 0.91 mm.

First Nymphal Stage.—General color of head and thorax, and their appendages, dark reddish brown, almost black, with whitish markings. Abdomen yellowish white with two conspicuous, reddish brown dorsal tubercles. After feeding, the abdomen takes on a light green color. Whole surface of insect glistening, with scattered, stiff, black hairs, arising from small black tubercles. Antennæ about equalling body in length, with second and third joints noticeably flattened. Length of body about 2 mm.[2]

Second Nymphal Stage.—Resembling first stage. General color of abdomen light grayish green. Dorsal surface of head, thorax, and abdomen, dull, pruinose. Length about 3 mm.

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[1] Guérin-Méneville, F. E., in Historia, Fisica, Politica y Natural de la Isla de Cuba. by R. de la Sagra, vol. VII, p. 159, pl. XIII, fig. 9, 1856.

[2] Descriptions of the nymphal stages have been made from living specimens. The lengths given are average ones and were taken soon after the specimens had molted.

THIRD NYMPHAL STAGE.—Differs from second stage in that dorsal surface of head, thorax, and abdomen is for the most part light grayish green, pruinose. Flattening of second and third antennal joints not so apparent as in preceding stages. Length about 5 mm.

FOURTH NYMPHAL STAGE.—General color darker than in third stage. Third and fourth joints of antennæ slightly flattened. Connexivum more pronounced than in preceding stages. Length about 7 mm.

FIFTH NYMPHAL STAGE.—General color darker gray than in fourth stage, largely due to greater abundance of tubercles on surface of body. Dorsal surface of abdomen also differs from that of fourth stage in having two marginal black spots on each of first six segments, and black on anterior margin of seventh segment. Joints of antennæ all cylindrical. Length about 9 mm.

ADULT.—The following description has been made from mounted specimens:

General color of dorsal surface dark brown, the ventral surface somewhat lighter, of a grayish brown. Ground color yellowish brown. Surface of body and appendages (except dorsal surface of abdomen, membranous portion of primaries, and all of secondaries) thickly spotted with small black tubercles from which arise short setæ. Outer edges and median dorsal line of prothorax light yellowish brown. Anterior third of dorsal surface of connexivum of abdominal segments 2 to 6, inclusive, light yellowish brown. The remaining, dark portions of the upper surface of the connexivum of segments 3 to 6, inclusive, have spots of the same color in their centers. Spine above base of antenna not prominent, scarcely 0.25 mm. in length.

Average length of ten males 13.4 mm., ranging from 12.5 mm. to 14 mm. Average width of prothorax 4.2 mm., ranging from 3.75 mm. to 4.25 mm.

Average length of ten females 15.7 mm., ranging from 15 mm. to 16.5 mm. Average width of prothorax 5.2 mm., ranging from 4.75 mm. to 5.5 mm.

The sexes may be separated, as in the case of *tristis* and *armigera*, by the difference in the ventral surface of the terminal segments of the abdomen.

LIFE-HISTORY

The period of incubation of the egg was found to vary at Baton Rouge from seven to eleven days during June, July, August and September, in a well ventilated insectary and in outdoor cages, eight and nine days being the usual length of time during June and July.

The length of the nymphal stages varied considerably, depending no doubt upon the temperature and moisture conditions, and upon

the food supply. Two lots of nymphs were kept under observation in cages placed over squash plants in the field with the following results:

TABLE SHOWING LENGTH OF INSTARS, BASED ON RECORD FOR FIRST INDIVIDUAL

Lot	Hatched	Second Instar	Third Instar	Fourth Instar	Fifth Instar	Adult
A.....	Aug. 26	Aug. 28	Sept. 3	Sept. 7	Sept. 13	Sept. 21
B.....	Aug. 28	Sept. 1	Sept. 6	Sept. 10	Sept. 15	Sept. 25
			Number of Days to Complete Instar			
A.....		2	6	4	6	8
B.....		4	5	4	5	10

HABITS

So far as observed the habits of this species are quite similar to those of *Anasa tristis* and *A. armigera*. Indeed, nymphs and adults of *andresii* and *tristis* are often found mingling together on the plants. In 1915 adults were first noted in the field at Baton Rouge on May 26 and soon afterwards eggs were found on squash. The eggs are usually deposited on the under surface of the leaves of the host plants, though they may be placed on the upper surface or on other portions of the plant above ground. They may even be laid on other vegetation or on objects in the vicinity of the food plants. They are placed in groups of varying size or even singly, fifty groups ranging in size from two to fifty eggs giving an average of fifteen per cluster. The eggs are arranged in no regular pattern and there is a tendency to place the eggs farther apart than is usual in the case of *tristis*.

Upon issuing from the eggs the nymphs cluster around the egg shells for a time but later become more or less scattered, being usually found on the under surfaces of the leaves, though they may also occur on other parts of the plant or beneath dead leaves and rubbish nearby. Oftentimes when the vines have been killed by the squash vine-borer (*Melittia satyriniformis* Hübn.), or from some other cause, the adults and the nymphs gather on any fruit remaining in the field.

The injury caused by the nymphs and adults is identical to that due to the attacks of *tristis*. Portions of the leaves from which the bugs have been extracting the juices wilt and later die, presenting the appearance of having been injured by fire.

TRIPHLEPS INSIDIOSUS AS THE PROBABLE TRANSMITTOR OF CORN-EAR ROT (DIPLODIA SP., FUSARIUM SP.)

By J. A. HYSLOP, *Bureau of Entomology, Washington, D. C.*

In the fall of 1912 we were advised of a severe outbreak of insects attacking corn in Maine. The writer was dispatched to investigate this outbreak and reached New Paris, Maine, on September 20, only to find that the injury was due to a form of ear rot which was doing its most severe damage to sweet corn in the large and important corn canning districts of that state. As the various forms of ear rot are not confined to sweet corn and, as Mr. Morrill, of the Burnham & Morrill Canning Company, believed that insects were largely responsible for this damage, a preliminary investigation was undertaken. I here wish to express my appreciation of the many favors shown to me by Messrs. Burnham and Morrill at whose plant most of the experiments were carried on.

The disease first makes it appearance as a small yellowish discoloration of that part of the kernel immediately about the point where the silk is attached and first appears when the corn is in the milk stage. This discoloration spreads over the entire kernel and eventually the epidermis ruptures. A viscid yellow liquid is exuded and finally the kernel breaks down into a putrid mass. The diseased areas are scattered and often run together, entirely destroying the ear. In the advanced stages of the disease, a compact white mycelium often covers the infected areas and several instances were noted wherein this mycelium had a decided pink cast. Material of this nature was sent in to Washington and was tentatively determined by the Mycologist of the Bureau of Plant Industry as *Bacterium stewarti* Erw. Sm. However, *Bacterium stewarti* is generally recorded as attacking the corn when it is very young, and when ears are infested the husk shows manifest symptoms. In the disease under consideration the husk was never damaged, the disease not being detected until the corn was husked. The second shipment of this material with brief notes was determined as *Fusarium spp.* or *Diplodia sp.*, the material being in too poor condition for exact determination. I am quite convinced, from the symptoms described by Burrill and Smith, that *Diplodia* is the actual causative agent. The cause of the disease, however, was not the phase of the problem that immediately interested us. Its method of transmission was the important entomological problem.

Fresh corn ears in the milk stage were used in the following experiment. The ears were carefully gathered from an uninfested field,

Forty ears were used in this experiment: ears Nos. 1–10 were punctured with a clean, heat sterilized, needle; Nos. 11–20 were punctured with a needle moistened with clean tap water; Nos. 21–30 were not punctured but were simply moistened on the outside of the kernels with a solution of the disease, and Nos. 31–40 were punctured with needles infected with the disease. In puncturing the kernels the husk was pulled back from part of the ear and a single row of kernels punctured. Sterile tissue paper was then placed over the exposed kernels and the husk replaced and fastened with a rubber band. The only case wherein we got infection was in the last series of ten ears, those infected by puncturing the epidermis of the kernels with infected needles. The day following the infection, a characteristic yellow discoloration was noticed around the point of infection in every kernel in the row infected. The second day following infection, the kernels were generally discolored and on the third day the epidermis of many had ruptured with the characteristic viscid exudations. This seemed to indicate that it was necessary that this disease should gain access to the kernel by means other than air-borne spores alighting upon the exposed tips of the ears, which was the theory advanced by several packers in this region, and that it was transmissible by subcutaneous injection. The only natural methods that suggested themselves to the writer were a root infection of the plant by which the disease gained access to the corn through the fibro vascular system, or an infection caused by the injury of the kernel by some insect which had previously been infected with the disease. A careful search was made in many of the worst infested fields and the only insect which seemed at all likely to be able to gain access to the corn within the husk was the small Heteropteron, *Triphleps insidiosus*. Large numbers of these insects were found in the fields where the disease was worst. They were in the silk, under the husk, and in the litter about the bases of the plants. As the season was then well advanced and the corn crop was pretty well harvested further field experiments with the insect were not possible. Since that time we have received no complaints of this disease attacking field corn and other problems have engrossed our time. Most of these diseases caused by *Diplodia* and *Fusarium* are supposed to pass the winter in the plant refuse and on the ground in the fields and thus to reinoculate the ensuing year's crop.

In 1914 Messrs. H. Garman and H. H. Jewett[1] published a short account of *Triphleps insidiosus* as a beneficial insect feeding on the eggs of corn-ear worm, *Chloridea obsoleta*. In this account they very minutely record their data on the egg laying of this insect. During the latter part of August the eggs are laid in the corn silk and hatch

[1]Ky. Agri. Exp. Sta., Bul. 187, p. 587.

in about three days, the insect reaching maturity in about fifteen days. As this insect is known to hibernate in the rubbish in the corn fields, the conclusion at which I have arrived is almost evident: The insects spending considerable of their time in the rubbish in the fields become infected with the disease, they oviposit in the corn silk, infection enters at the point of oviposition and travels down the corn silk to the ovary of the corn. The evidences in favor of this conclusion are: the characteristic starting points of discoloration of the kernel at the base of the corn silk, the fact that the disease will occur on several points of the ear often distant from the tip, and that the disease is not one of the forms which attack the plants through the roots and fibro vascular system nor can be introduced by air-borne spores alighting upon exposed parts of the ear. In fact, in many cases ears were badly rotted wherein the husk was tight and extended considerably beyond the tip of the ear.

Should this hypothesis prove to be the fact, *Triphleps insidiosus* will assume quite a different rôle than it has assumed in the past. It has been recorded as a very beneficial insect as far back as 1881 when Riley[1] recorded this insect as a natural enemy of *Blissus leucopterus*. In 1900 Dr. S. A. Forbes[2] gives this insect as a natural enemy of *Blissus leucopterus*, *Phylloxera*, *Thysanoptera*, eggs of *Heliothis obsoleta* and larvæ of *Diplosis sorghicola*, and Garman and Hewitt add *Coccidæ* and *Aleyrodes vaporarium*. As a noxious insect, this is not the first record by any means. It has been recorded as damaging plants as far back as 1888 in an unsigned article published in Garden and Forest, August 22, wherein it was stated that many of the Chrysanthemum collections around Boston were being seriously damaged by this insect piercing the ends of the shoots and causing the leaves to curl up and wither. Dr. E. P. Felt[3] records this insect as doing damage to squash vines, and Professor Herbert Osborn found them damaging the blossoms of red clover. It is possible that the injury in these cases is purely physical, destroying the plant tissue by withdrawing the sap. It is not impossible, however, that, in these cases also, parasitic fungi introduced by the mouthparts or ovipositor of the insect were largely responsible for the destruction of the plant tissues.

The probability of the transmission of *Diplodia* and *Fusarium* by *Triphleps insidiosus* serves to accentuate the remedial measures generally suggested in combating these diseases; not replanting fields to corn that have borne a diseased crop, and destroying the leaves and stubbles in all infested fields. It is not even advisable to use this litter

[1] Amer. Agri. Tec. 1881, Vol. 40, p. 515.
[2] Bul. 60, Ill. Agri. Exp. Sta.
[3] Am. Garden, Sept. 10, 1898.

as stock feed, as the pile of fodder would undoubtedly serve as a hibernating place for these insects. Probably the most advisable procedure would be to cut the corn with as short a stubble as possible immediately after gathering the crop and burn it in wind rows in the infested fields. Then fall plow the field, plowing as close to the fences as possible to destroy possible hibernation quarters.

SARCOPHAGIDÆ OF NEW ENGLAND: GENUS SARCOPHAGA

By R. R. Parker

Sarcophaga aldrichi, n. sp.

Type ♂: Massachusetts Agricultural College.

Paratypes (♂): Massachusetts Agricultural College, one; United States National Museum, two (No. 19165); Boston Society of Natural History, one; Gypsy Moth Parasite Laboratory, Melrose Highlands, Mass., three; collection of Dr. J. M. Aldrich, one; collection of author, one.

(♂) Vestiture of both thorax and abdomen hairy throughout; only presutural pair of anterior acrostichals present, weak; anterior femur with but two rows of bristles, an upper and a lower, or, if present, bristles of intermediate row are very slender and hair-like; posterior face of posterior tibia with a row of scattered long hairs on distal half; second genital segment black or blackish.

Length.—8½ to 11½ mm.

Head.—Viewed from side parafrontals and genæ with dark reflections, transverse impression sometimes with a reddish tinge. Breadth of front at narrowest part about one half eye width; cheek height approximately one half that of eye. Front prominent; sides of frontal vitta converging backward by straight lines, rarely parallel. Second antennal segment dark; third about twice length of second; arista plumose on basal half or slightly more. Back of head somewhat convex with three or four rows of black cilia behind eyes, otherwise clothed with yellowish white or whitish hair that completely covers metacephalon. Cheeks clothed with black hair. Genæ clothed with scattered hairs. Palpi dark.

Chætotaxy.—Lateral verticals absent; vibrissæ sometimes inserted on line of oral margin, but usually very slightly above.

Thorax.—Metanotum clothed with fine, erect hair that is sometimes quite long. Hairs covering anterior spiracle dark basally, lighter toward tips; those of anterior margin of posterior spiracle dark brown; those of spiracular cover brownish with yellowish tips. Epaulets dark.

Wings.—Bend of fourth vein normally a right angle; anterior cross-vein more basal than end of first longitudinal; third vein bristly; costal spine vestigial; section III of costa slightly greater than section V; alulæ fringed with hairs; calypters whitish, margins fringed with whitish or slightly yellowish hairs.

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[1] Contribution from the Entomological Laboratory of the Massachusetts Agricultural College.

Legs.—Dark. Posterior trochanter without "brush" or latter so small as not to be distinguishable as such: femur cylindrical or sub-cylindrical, clothed beneath with medium long, scattered hair; anterior face with three rows of bristles, those of intermediate row shortest and not developed distally; posterior face without ventral row of bristles: tibia straight or slightly curved, a row of scattered, long hairs on distal half of lower posterior face: tarsus equal in length to tibia, fourth segment at least one half fifth. Middle coxa with a single row of bristles: femur clothed beneath on posterior, proximal half with fine, but rather short hair; anterior ventral row of short bristles complete, posterior row represented by "comb" on distal one-third to two-fifths: submesotibial bristle present. Anterior coxa with two rows of bristles; femur usually with two rows, but if three are present, intermediate row consists of very fine, hair-like, scarcely distinguishable bristles.

Chetotaxy.—Bristles usually long and slender. Anterior dorsocentrals, as a rule, scarcely shorter than posterior; only presutural pair of acrostichals developed, slender, others rarely present and if so, very hair-like; inner presuturals slender, nearly as long as anterior dorsocentrals: four pairs postsutural dorsocentrals; prescutellar acrostichals present: scutellar apicals present: sternopleurals, sometimes both sides with three or two but very commonly two on one side, three on the other: lower sternopleura with a single row of bristles, otherwise with long hair.

Abdomen.—Somewhat conical or slightly oval; hairy vestiture longer and finer beneath. Ventral plates, as a whole, with their sides slightly converging posteriorly, almost parallel; at sides vestiture long on all three, but centrally vestiture of third shortest and erect.

Chetotaxy.—Second segment usually without marginal bristles, at most they are hair-like and decumbent; third with two and often with weaker, hair-like bristles between these and laterals; fourth with complete row ending ventrally in long hairs.

Genital Segments.—Not conspicuous, normally but small part of first showing, often only membranous band joining the segments. First (g. s_1) ground color varies from brownish orange to blackish, grayish pollinose except "humps" which are not differentiated, vestiture about equal in length to that of second, in profile slightly arched, marginal bristles absent: second (g. s_2), rotund, anal area flattened and extending about to upper limit of posterior surface; shining black, often faintly grayish pollinose, sometimes with a brownish tinge. Forceps, normally not visible, blackish brown or orange brown; prongs flattened, their inner edges meeting ridge-like for more than two thirds their length then separated, but tips so bent that edges normally meet just before the extremities of prongs, the latter spreading slightly, vestiture increases in length and amount basally; base with upward flap-like extensions. Connecting membrane just anterior to "humps" with a row of long, slender hairs on each side.

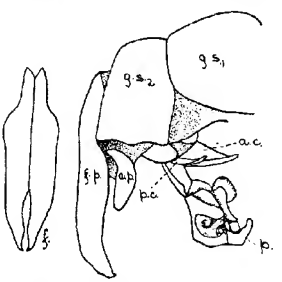

Fig. 31. *Sarcophaga aldrichi*, genital segments.

Genitalia.—Heavily chitinized portions of head of penis (p.) black or blackish: anterior claspers (a. c.) broad and flattened: accessory plates (a. p.) brownish orange, hairy, and with an almost linear extension that parallels forceps for a way. Inner edges of lancelike of fourth ventral plate fringed with hairs. (p. c. = posterior clasper.)

(♀) Not definitely known.

Described from 11 male specimens, 71 others examined.

RANGE.—New England: Mass.; Wellesley, Westfield, Melrose Highlands, Harwich, Forest Hills, Lunenburg.

United States: N. Y.

Foreign: Canada (Quebec).

This species is named in honor of Dr. J. M. Aldrich.

The bristles are long and slender, except on the legs. It is peculiar that the left sternopleura often bears two sternopleurals, the right one three, while in none of the specimens examined was the reverse condition found. The rows of cilia should be counted on that portion of the back of the head which is nearest the epicephalon. In exposing the genitalia the forceps are likely to be spread and flattened out so that they do not appear normal.

S. aldrichi is extremely similar to *S. uliginosa* Kramer. Though the penes are distinctive, those external characters which have a differential value are somewhat variable. The most constant distinctive character seems to be the presence of a row of long, scattered hairs on the distal half of the lower posterior face of the hind tibia, while in *S. uliginosa* the hairs are close set and form a distinct beard on the distal three-fourths. The number of rows of black cilia behind the eyes, commonly a reliable specific character, varies in both species. In *aldrichi* there are usually but two rows of bristles on the anterior femur, but sometimes an intermediate row is weakly developed: *uliginosa*, on the other hand, commonly has three rows though occasionally the intermediate one is so weak as to resemble that condition in *aldrichi*. *Uliginosa* seems to constantly have three sternopleurals, in *aldrichi* the number varies. In the former anterior acrostichal bristles, except the presutural pair, are usually absent, while in *uliginosa* all are commonly present; but again this character varies in both. Though the penes are specific, the fourth ventral plates are alike, as are also the forceps.

S. aldrichi agrees with *S. uliginosa* Kramer, *S. utilis* Aldrich, *S. sarraceniæ* Riley, *S. exuberans* Pandellé, *S. harpax* Pandellé and three undescribed New England species in the absence of marginal bristles on the first abdominal segment. These bristles are sometimes absent in *S. sinuata* Meigen. It agrees with *S. uliginosa* Kramer, *S. sarraceniæ* Riley, *S. exuberans* Pandellé, *S. harpax* Pandellé, *S. hæmorrhoidalis* Meigen, *S. dalmatina* Schiner, *S. falculata* Pandellé and one undescribed species in the presence of a row of long, slender hairs on each side of the connecting membrane just anterior to the humps of the first genital segment. This is rather obscure, and interesting to show

possible relationship rather than as a convenient specific character. These hairs are always in line with the spiracles on each side and the significance of their presence is not quite clear, unless as representing the remains of the vestigial sixth abdominal segment, the so-called fourth ventral plate of taxonomy being its sternum.

Among material examined from the Gypsy Moth Laboratory at Melrose Highlands were a number of specimens of *S. aldrichi* recorded as reared from pupæ of *Porthetria dispar* (L.), collected at Melrose, Wakefield, North Saugus, Woburn, North Andover, Beverly, Essex, Topsfield, Gloucester, and Swampscott. Certain of these cities should appear under the range, but there are no means of discrimination. Of Sarcophagidæ collected at Lunenburg, Massachusetts, during the summer of 1914 by R. T. Webber of the Gypsy Moth Laboratory, this species is by far the most numerous.

I am indebted to Professor J. M. Aldrich for the following notation which he received from Professor Lawson Cæsar, Provincial Entomologist of Ontario: "In the last three years forest tent caterpillars (*M. disstria*) have been very abundant in the eastern parts of Ontario. Last year when visiting that part of the province on some entomological work, I observed that nearly 90 per cent of the cocoons opened in July showed the presence of a dipterous larva, which I supposed would be a Tachinid. However, from about two dozen of these cocoons brought back with me to Guelph there have emerged eight Sarcophagids and no Tachinids." Specimens were determined by Dr. Aldrich as *S. aldrichi*.

While examining material collected at Lenox, Massachusetts, during June, 1915, by C. W. Johnson of the Boston Society of Natural History, this species was noted to be very numerous. Conversation with Mr. Johnson established the fact that caterpillars of *Malacosoma disstria* Hübner were abundant in that locality.

Except for a few scattered specimens captured in isolated localities, the only records the writer has of the occurrence of this species in abundance have been where there were larvæ of either *Porthetria dispar* or *Malacosoma disstria*, especially the latter. The true status of this species in the economy of nature may be a point worth determination.

Scientific Notes

Forest Insect Investigations (A. D. Hopkins, In Charge). S. A. Rohwer, Bureau of Entomology, has recently completed a summary of the nursery connected with the eastern Field Station, arranging it under the heads of "Deciduous" and "Coniferous" trees.

There are twenty-six species of deciduous trees represented in the nursery by one hundred and fifty-eight individuals. Most of these are oaks and are used in experiments on leaf-feeding insects and gall makers.

In the coniferous nursery there are twenty-six species represented by one thousand three hundred and thirty-eight individuals. Four new conifers have been added to the nursery since last report. These are *Pinus scopulorum*, *Pinus edulis*, *Pinus laricio*, and *Pinus tæda*.

Since the last report one hundred and fifty-four trees have been numbered and individual observations are being kept on these trees, in connection with the experiments with the insects. Most of these trees are being used in experiments on the two recently introduced pests, *Evetria buoliana* and *Diprion simile*.

It is noted that most of the seedlings which came from the Pacific Coast had the foliage winter killed and were considerably later in commencing to grow than species from other localities. An interesting comparison can be made between the two plots of *Pseudotsuga taxifolia*. In one of these the seedlings came from Oregon and every tree showed considerable winter killing of the foliage. In the other plot the seedlings came from Colorado and there was no winter killing of the foliage of these trees.

Federal Horticultural Board. The fumigation of imported cotton is now proceeding in Boston and San Francisco in a thoroughly satisfactory manner. In the use of a substance as poisonous as hydrocyanic-acid gas in such huge quantities, there is necessarily risk unless thorough-going precautions are constantly taken. The existence of such risk has been two or three times demonstrated already in the work in Boston, with no serious consequences, however, other than the temporary disabling of workmen. In every instance, however, these accidents have resulted from carelessness and disregard of precautionary measures which have been specifically insisted upon. It is believed that this experience will control any further tendency to carelessness on the part of the workmen concerned. The investigation of the fumigated cotton by the experts of the Federal Horticultural Board, and of the Bureau of Chemistry, of this Department, has shown that after an aeration of a day or two the fumes of the gas have practically entirely disappeared, and no further danger from fumigated cotton is possible.

During the month of May the following quarantines have been promulgated: Notice of Quarantine No. 24, on "Corn Diseases." Notice of Quarantine No. 25, "Gipsy Moth and Brown-Tail Moth Quarantine."

The corn disease quarantine prohibits the importation, in the raw or manufactured state, from southeastern Asia (including India, Siam, Indo-China, and China), Malayan Archipelago, Australia, New Zealand, Oceana, Philippine Islands, Formosa, Japan, and adjacent islands, of seed and all other portions of Indian corn or maize (*Zea mays* L.), and closely related plants, including all species of Teosinte (*Euchlæna*), Job's tears (*Coix*), *Polytoca*, *Chionachne*, and *Sclerachne*. This quarantine has some entomological importance in that, though directed against corn diseases,

it operates at the time to exclude any possible further entry of any oriental insects attacking this cereal.

The gipsy-moth and brown-tail moth quarantine embodies the annual revision of the territory, necessitated on account of changes in distribution of the two insects. Provision for the inspection and certification of Christmas trees has been continued for another year. Arrangements have also been made for notifying the proper state officials of all shipments of certified products from the quarantined territory, in order that the states may have a chance to reinspect such products if desired.

Mesogramma polita Say. On July 10, 1916, while upon a collecting trip about six miles south of the city of Baton Rouge, I came to a small field of corn which was infested by Syrphid larvæ. Taking particular notice of them, I found they were feeding upon the pollen grains which had fallen down on the leaves, and were the most numerous at the junction of the leaves with the main stalk. In that place considerable moisture remained during the entire day. Later I found that the larvæ would feed out upon the leaves during the early part of the morning as long as the dew was present but retreated to the base of the leaves as the dew disappeared.

Recalling Mr. C. H. Richardson's article upon "corn-feeding" Syrphid larvæ in the June issue of the JOURNAL, I collected a number of the larvæ and later at the laboratory reared the same by feeding them upon the pollen of corn. From the pupa emerged the adult flies of *Mesogramma polita*, Say.

Wishing to be certain of my identification I sent the specimens to Dr. L. O. Howard and they were identified by Mr. F. Knab as *Toxomerus politus*, Say. (Synon.).

O. W. ROSEWALL,
Louisiana State University, Baton Rouge, La.

Report on Gipsy Moth Conference held in Boston and Vicinity, July 7 and 8, 1916. A summer conference on gipsy moth work was held on July 7 and 8 for the purpose of visiting different sections of the infested territory and observing the methods used in the field and at the Gipsy Moth Laboratory. The following visitors were present: Mr. L. S. McLaine, Fredericton, N. B.; W. A. Osgood, Durham, N. H.; F. W. Rane, Boston, Mass.; George A. Smith, Boston, Mass.; R. L. Kneeland, Boston, Mass.; H. T. Fernald, Amherst, Mass.; J. J. Pillsbury, Providence, R. I.; Harry Horovitz, Providence, R. I.; I. W. Davis, New Haven, Conn.; George G. Atwood, Albany, N. Y.; C. L. Marlatt, Washington, D. C.; W. E. Hinds, Auburn, Ala., and Alden T. Speare, Washington, D. C.

The members of the staff of the Bureau of Entomology connected with moth work also attended the meeting and field trips. The visitors assembled at the office of the Bureau of Entomology, 43 Tremont Street, Boston, at 10 o'clock and proceeded to Plymouth, Mass. In the afternoon a number of badly infested areas were inspected in the town of Plymouth and vicinity. The night was spent at Plymouth and in the morning the party proceeded to the Bussey Institution at Forest Hills, where an inspection was made of the work which is being carried on in regard to the wilt disease of the gipsy moth. In the afternoon a demonstration was given of high-power spraying with the automobile truck sprayer of the Bureau of Entomology. The party then proceeded to the Gipsy Moth Laboratory at Melrose Highlands, and examined the work which is being carried on there.

The meeting was called for the purpose of giving an opportunity of seeing the field conditions and field work, hence no papers or reports were given.

Those who attended expressed much satisfaction at having an opportunity to see the work during the time when the caterpillars are the most destructive.

A. F. BURGESS

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1916

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. Photo-engraving, may be obtained by authors at cost. The receipt of all papers will be acknowledged.—Eds.

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The meeting of the Pacific Slope Branch will be held just after the forms for this number are closed and much too late for any notice in this issue. We take this opportunity of extending best wishes to our Pacific Slope members and to express the hope that the San Diego meeting may be a most pleasant and profitable one.

The Nova Scotia Entomological Society, a branch of the well known Entomological Society of Ontario, was organized in August 1915. The recently issued proceedings (No. 1) of this organization contains valuable articles relating to both economic and systematic entomology and may be taken as an earnest of a long and successful career. The accounts of injury to apple trees by the false tarnished plant bug and the date relating to the apple maggot are particularly interesting to the economic entomologist.

The food value of insects, as pointed out by one writer in this issue, is most certainly worthy of investigation. Many species are very abundant under certain conditions and if methods of collecting and preparing them for food are well understood, it would mean much for many in moderate circumstances and there is the possibility that studies along this line would not be without significance for the epicure. There is not only an opportunity to take advantage of the unusual numbers of insects which now occur under natural conditions

or at least without intentional assistance from man, but the short life cycle and the great prolificacy of certain insects suggests the possibility of using some forms as an agent in rapidly transforming comparatively worthless materials into a food possessing not only nutritious but appetizing qualities. In other words, there are possibilities in rearing insects for food as well as for the production of honey, dyes or silk deserving careful attention.

Aphis or Aphid. The undersigned have carefully considered the question raised by Dr. Chittenden as to the use of the words "plant lice," "aphid," etc., in publications of the Bureau of Entomology. It appears that the following terminology relative to common names of species of Aphididæ should be adopted in Bureau publications:

(1) Aphis should be used in connection with some other modifying word as, the "woolly apple aphis," "corn aphis," "box-elder aphis," etc. This conforms to the practice adopted by the American Association of Economic Entomologists.

(2) The word "aphid" or "aphids" (plural) should be used in referring to plant lice in general. While the origin of the word "aphis" is unknown it has apparently been latinized and should properly be rendered in English, as Dr. Chittenden suggests, as aphidid or aphides. However, since the word "aphid" is given preference in most dictionaries, and is almost exclusively used by students of Aphididæ, it does not seem good policy to attempt to change a practice so well fixed.

As regards the use of the word "plant-louse," this should be abandoned and "aphid" employed in its place.

C. L. Marlatt
A. L. Quaintance
W. D. Hunter

Notes on the Distribution of the Clover-Leaf Weevil (*Hypera punctata* Fab.) in Kansas. In his paper "The Genera Hypera and Phytonomus in America, North of Mexico" (*Ann. Ent. Soc. Amer.* 1911, Vol. 4, pp. 383–473), Titus records *Hypera punctata* Fab. from North Topeka, Kansas. In so far as the writer can learn this is the only record of this species being taken in Kansas.

While investigating a cutworm outbreak in alfalfa near Independence, Kansas, on May 25, 1914, the writer found three adult clover-leaf weevils under a small pile of alfalfa. On June 4, 1914, while engaged in similar work near Leavenworth, Kansas, over one hundred specimens of this insect were found under a pile of alfalfa.

On June 13, 1916, while collecting insects at Manhattan, Kansas, on submerged vegetation following a heavy rain, the writer found three clover-leaf weevils clinging to heads of peppergrass. Since then one of the collectors for the department has collected specimens of this insect in limited numbers from widely separated fields in the vicinity of Manhattan.

These collections show the clover-leaf weevil to be present in Eastern Kansas in widely separated localities, ranging from the northern to the southern parts of the state. The infestation also extends into the state to a distance of at least one hundred twenty-five miles.

James W. McColloch, *Assistant Entomologist,*
Kansas Agricultural Experiment Station

Current Notes

Conducted by the Associate Editor

Mr. W. F. Fiske, who is now in London, has written that he will be in the United States on the 15th of July.

Mr. A. H. Robinson has been appointed field assistant in the Bureau of Entomology with headquarters at Plymouth, Ind.

According to *American Fruits*, "Dr. A. J. Cook, formerly Horticultural Commissioner of California, is seriously ill of cancer."

Geo. S. Demuth, Bureau of Entomology, is at Fennville, Mich., continuing his work on the effects on bees of spraying fruit trees.

Mr. R. M. Garner has been engaged by the Bureau of Entomology to assist in work on truck crop insect investigations at Norfolk, Va.

Mr. Wm. N. Ankeney, from Ohio State University, is field assistant of the Bureau of Entomology, and stationed at Big Rapids, Mich.

Mr. August Busck, of the Bureau of Entomology, has been granted leave of absence to make a short visit to his old home in Denmark.

B. R. Coad, A. C. Morgan, and D. L. Van Dine, of the Bureau of Entomology, were in Washington for conferences during the month of May.

Mr. A. D. Borden, of the Bureau of Entomology, recently visited some large growers of greenhouse plants in Maryland, Pennsylvania, and New Jersey.

Dr. C. H. T. Townsend, of the Bureau of Entomology, accompanied by Carl Heinrich, made an extensive collecting trip in New Mexico during July.

Professor J. H. Comstock has been elected as one of three delegates to represent the faculty of Cornell University at the meeting of the board of trustees.

Dr. L. O. Howard left Washington on June 5 for a trip of about six weeks' duration to the southern and western field laboratories of the Bureau of Entomology.

Mr. James I. Hambleton, of the University of Wisconsin, has been appointed field assistant of the Bureau of Entomology, and will be stationed at Madison, Wis.

According to *Science*, Dr. David D. Whitney has been appointed professor and Professor Homer B. Latimer associate professor of geology at the University of Nebraska.

Professor Herbert Osborn, of the Ohio State University, is engaged in special research at the Agricultural Experiment Station, Orono, Me., during the summer vacation.

Mr. A. T. Speare, Bureau of Entomology, made a short trip to Hagerstown and Smithsburg, Md., in connection with observations on a fungous disease of *Eulecanium nigrofasciatum*.

Mr. G. W. Barber, of the Bureau of Entomology, recently attached to the Charleston, Mo., field station, has been transferred to the range-caterpillar work, located at Maxwell, N. Mex.

Mr. Harold Westcott has been engaged by the Bureau of Entomology as assistant to D. E. Fink at the Virginia Truck Experiment Station, Norfolk, Va.

The seventh annual field meeting of the Connecticut Beekeepers' Association was held at the Connecticut Agricultural College, Storrs, Conn., August 3 and 4.

Mr. James K. Primm, of the University of Illinois, has been appointed to assist D. Isely at North East, Pa., in grape-insect investigations of the Bureau of Entomology.

Mr. F. A. Johnston, Bureau of Entomology, is in charge of the field station at Big Rapids, Mich., his former headquarters at Hart, Mich., being retained as a substation.

Mr. W. D. Pierce, Bureau of Entomology, is on an extended trip to determine the status of the boll weevil, especially in the regions which were invaded for the first time last season.

Mr. E. R. Selkregg, of the Massachusetts Agricultural College, has been appointed to assist H. G. Ingerson at Sandusky, Ohio, in grape berry-moth investigations of the Bureau of Entomology.

On June 7, 1916, Tulane University conferred the degree of Doctor of Laws upon Dr. W. D. Hunter, in charge of the Southern Field Crop Insect Investigations, of the Bureau of Entomology.

Mr. G. F. Ferris, assistant in entomology at Stanford University, is temporarily located in Washington, D. C., and is devoting considerable time to the study of Coccidæ with Harold Morrison.

Mr. J. J. Pillsbury, scientific assistant at the Gipsy Moth Laboratory of the Bureau of Entomology, has recently resigned to accept the position of Assistant State Entomologist of Rhode Island.

The states of Idaho and Wisconsin have recently announced a quarantine as regards certain species of pines from the Northeastern States where the white pine blister rust is known to occur.

Mr. C. M. Packard, of the Bureau of Entomology, recently inspected the Sacramento Valley of California in search of Hessian fly and reports that the pest is apparently absent there at this time.

Messrs. T. P. Cassidy and W. B. Williams, students in the Mississippi Agricultural College, have been appointed temporary field assistants of the Bureau of Entomology under B. R. Coad at Tallulah, La.

Messrs. Hunter H. Kimball and James F. Curry have been appointed temporary field assistants of the Bureau of Entomology for assignment to the malaria mosquito investigation under Dr. D. L. Van Dine.

Mr. A. C. Baker, Bureau of Entomology, has been visiting orchards in the vicinity of Crozet, Staunton, and Winchester, Va., making observations on certain apple aphids, especially *Aphis malifoliæ* Fitch.

Mr. E. B. Pence has been appointed an assistant for temporary service at the laboratory at Clarksville, Tenn., under A. C. Morgan, of the Bureau of Entomology.

A short course in Apiculture was given at the Ontario Agricultural College at Guelph, Ontario, January 11–22, 1916, for the sixth year. A summer school was also held from June 12–16.

Mr. A. W. J. Pomeroy, who is now a captain in the third Nigerian Regiment, is in this country for a short time on leave. He is to return to active service in British West Africa on July 26.

Mr. W. S. Fisher, Bureau of Entomology, spent most of the month of June in the vicinity of Harrisburg, Pa., in continuation of his researches on the seasonal history of the hickory-bark beetle.

Miss Cora H. Clarke, of Boston, a collector and student of insect galls, died April 2, 1916, at the age of sixty-five years. Miss Clarke has published several papers on insect galls and caddis-flies.

The station of the Bureau of Entomology formerly maintained at Elk Point, S. D., has been transferred and the present address of this station is 5205 Morningside Avenue, Sioux City, Iowa.

Mr. J. N. Knull, a graduate of Pennsylvania State College, was appointed May 1 as temporary field assistant of the Bureau of Entomology and assigned to assist Mr. Craighead at East Falls Church, Va.

Mr. N. F. Howard, Bureau of Entomology, will be engaged in the same line of investigations as last year with headquarters at Madison, Wis.; his former station at Green Bay will be retained as a sub-station.

Dr. A. L. Quaintance, Bureau of Entomology, recently visited laboratories of the Bureau at Monticello and Orlando, Fla., as well as other points in Florida and Georgia, making observations on deciduous fruit insects.

Mr. C. H. Popenoe, Bureau of Entomology, has returned from his tour of inspection in the states in which investigations are being carried on regarding the status and control of insects as carriers of cucumber diseases.

The new department of forest zoölogy has been established in the College of Forestry at Syracuse University, and Dr. Charles C. Adams has been promoted to a full professorship and will have charge of this department.

Mr. Irving L. Bailey, Bureau of Entomology, formerly connected with the gipsy-moth force, has been transferred to the Federal Horticultural Board to assist in the supervision of the disinfection of imported cotton at Boston.

Dr. N. E. McIndoo, Bureau of Entomology, spent about two weeks at Winchester, Va., making observations on the effect on bees of spraying orchards. He also spent some time in the general vicinity of Fennville, Mich., in similar work.

Mr. R. I. Smith, who is in charge of the Federal Horticultural Board's office in Boston, reports that since March 10, 1916, something over 65,000,000 pounds of cotton have been disinfected by the two fumigation companies in that city.

Mr. F. E. Brooks, Bureau of Entomology, engaged in fruit-tree borer investigations, with headquarters at French Creek, W. Va., spent some time visiting apple orchards in the Northern States, making observations on fruit-tree borers.

Dr. W. D. Hunter visited the laboratories at New Orleans, Mound, Tallulah, and Dallas during June. With Dr. Howard he attended the annual field meeting of the Louisiana Sugar Planters' Association at New Orleans on June 8.

Mr. A. G. Davis, a student of Tulane University, has been appointed a temporary field assistant in the Bureau of Entomology for service in connection with the shipment of parasites of the sugar-cane borer from Cuba to the laboratory at New Orleans.

Mr. Edward P. Van Duzee, instructor in Entomology at the University of California at Berkeley, has resigned to accept the position of Curator of the Department of Entomology of the California Academy of Sciences, Golden Gate Park, San Francisco, Cal.

Mr. H. K. Laramore, a graduate of Purdue University, formerly field assistant at Knox, Ind., where he was engaged in investigation on the cotton thrips, will take charge of the pickle-disease insect-problem station of the Bureau of Entomology at Plymouth, Ind.

Mr. R. A. Cushman, Bureau of Entomology, engaged in investigations of parasites of deciduous fruit insects, has returned to his field headquarters at North East, Pa., where he will continue his studies of Hymenopterous parasites of the grape-berry moth and other insects.

Mr. R. N. Wilson, Bureau of Entomology, reports that experiments relating to *Laphygma frugiperda* carried on in Florida and Georgia during the past winter indicate that the insect did not succeed in surviving the winter much north of the latitude of Gainesville, Fla.

Mr. F. X. Williams, Bureau of Entomology, who has been employed on the Gipsy Moth Work, has accepted a position with the Hawaiian Sugar Planters' Experiment Station. He will proceed to the Philippine Islands and assist in collecting parasites for introduction to Hawaii.

Mr. D. G. Tower, Bureau of Entomology, who was detailed for seven weeks to assist in the fumigation of cotton in Boston, returned to Washington, and is now temporarily located in Newark, N. J., supervising the fumigation of cotton at the plant recently erected by the Clark Thread Company.

Dr. A. L. Quaintance, Bureau of Entomology, recently visited Sandusky, Ohio, where a conference was held with Prof. H. A. Gossard and W. H. Goodwin, of the Ohio Agricultural Experiment Station, and Messrs. Dwight Isely and H. G. Ingerson, of this Bureau, in connection with inauguration of grape-berry moth investigations in Northern Ohio.

Plans are under way by the Bureau of Entomology for beginning demonstration work in beekeeping during the next fiscal year. The work will be inaugurated in certain Southern States, including North Carolina, where E. G. Carr made a preliminary survey last autumn. The work will be conducted in coöperation with the States Relations Service.

Dr. R. R. Parker, of the Massachusetts Agricultural College, was recently appointed a scientific assistant in the Bureau of Entomology but was forced to decline on account of reasons connected with his family. Dr. Parker has specialized in the *Sarcophagidæ* and during the summer of 1914 and 1915 was in the employ of the

Montana Board of Entomology. He has recently published several important papers.

The heavy packing used in the wintering of the colonies in the Drummond apiary of the Bureau of Entomology proved quite beneficial, the only colonies lost during the winter being those which were so weak in the fall as to make wintering virtually impossible.

Mr. F. M. Wadley, a senior at the Kansas State Agricultural College, and formerly field assistant in the Bureau of Entomology in investigations under the direction of F. B. Milliken, at Wichita, Kan., has been reëngaged to assist in the same work for the present season.

Mr. A. T. Speare is very anxious to obtain scale insects of the genus Lecanium, or its near relatives, that are parasitized by fungi, and specimens of these insects from any host plant will be gratefully received. (Address: A. T. Speare, Bureau of Entomology, Washington, D. C.)

Mr. S. A. Rohwer, of the Bureau of Entomology, is anxious to get *Cimbex* larvæ. He wants live material of large larvæ with host, locality, and other data. They should be sent to him in tin boxes stocked with food and addressed to East Falls Church, Va., Forest Insect Field Station.

Mr. R. E. Campbell, Bureau of Entomology, who has been in charge of an experiment station at Hayward, Cal., will remove to Pasadena, Cal., as new headquarters, retaining Hayward as a sub-station. He will continue work on insects injurious to stored products, to sugar beets, and to truck crops.

Mr. H. E. Smith, Bureau of Entomology, reports that an inspection of the region in the Merrimac Valley of New England which was heavily infested with grasshoppers and treated with poisoned baits last summer, reveals the fact that very few grasshopper eggs are to be found alive this spring.

According to *Science*, Dr. Frank E. Lutz, of the American Museum of Natural History, New York, and Mr. J. A. G. Rehn, of the Academy of Natural Sciences, Philadelphia, have planned to spend July and part of August making a field study of the insect fauna of the isolated mountains southwest of Tucson, Ariz.

Mr. Raphael Zon, Chief of Forest Investigations, of the Forest Service, spent several days during the latter part of May inspecting the silvicultural experiments and conferring in regard to the coöperative work which is being carried on by the Bureau of Entomology and the Forest Service in connection with the gipsy moth problem.

An extension project has been started by the Bureau of Entomology in coöperation with the South Carolina Agricultural College. The object of the work is to place the results of the recent investigations of the cotton wireworm in the possession of planters throughout the state. This is the first project of this kind which has been organized in the Bureau.

At the invitation of Mrs. John Dickson Sherman, Chairman of Conservation of the General Federation of Women's Clubs, the branch of Forest Insect Investigations of the Bureau of Entomology coöperated in an exhibit under the auspices of the Federation in the 7th Regiment Armory, New York City, held May 23 to June 1. The exhibit consisted of specimens of the work and insects of the hickory barkbeetle, *Scolytus quadrispinosus* in hickory, and the two-lined chestnut borer, *Agrilus bilineatus* affecting oak. Placards, with specimens of work of the two insects and folders

giving illustrations of the character of the insects' work and describing causes and remedies and calling special attention to the importance of community effort in control operations, were also on exhibition and for distribution.

According to *Science*, Chicago University on its twenty-fifth anniversary conferred the honorary degree of Doctor of Science on Professor William Morton Wheeler, dean of the faculty of the Bussey Institution of Harvard University.

Mr. H. L. Sanford, Bureau of Entomology, recently collected what appears to be a new and undescribed species of *Aonida* on condurango pods from Ecuador. On April 1 he also intercepted *Parlatoria chinensis* on peach from Northern China. This scale insect is a common and widespread species in Northern China and represents a very undesirable importation.

Mr. W. W. Yothers, Bureau of Entomology, in company with Messrs. W. J. Krome and L. S. Tenny, members of the Florida Plant Board, left Orlando on June 19 for a brief trip to Cuba to study the various insects infesting citrus on this Island. En route Mr. Yothers will stop off at various points on the Florida Keys to further investigate insects infesting limes.

Dr. Paul Marchal has prepared a book which will soon appear giving an account of his visit to America. The title, translated, is "The Biological Sciences Applied to Agriculture and the Struggle against the Enemies of Plants in the United States." The volume will cover about 400 royal octavo pages, and is enthusiastic in its praise of the organization of the Bureau of Entomology.

Mr. C. H. Popenoe, Bureau of Entomology, will visit the stations which have been established, in coöperation with the Bureau of Plant Industry, for investigation of insects as carriers of mosaic, wilt, and other diseases of cucumbers and other cucurbits in the states of Wisconsin, Michigan, and Indiana. He will supervise the preparation of experimental plats with reference to the control of these insects and for community demonstration experiments.

Messrs. A. F. Burgess, D. M. Rogers, and L. H. Worthley were in Washington during May to attend the hearing before the Horticultural Board on the quarantines of the gipsy and brown-tail moths. It was decided by the Board that the present provision under which Christmas trees and greens are shipped from the infested territory under inspection will be continued. It was also decided that notices of all shipments which are inspected under the quarantines will be sent to the officials in the states to which they are forwarded.

The beet or spinach leaf-minor (*Pegomya vicina* Lint.) has been reported injurious in various sections of New York, and especially on Long Island, to table beet and Swiss chard, the latter being a new food plant. Agents and correspondents will assist in investigations of this insect if they will kindly send leaves of sugar beet, table beet, spinach, and chard, infested by this insect for possible rearing of parasites. Nicotine sulphate and other reagents should be tested as repellents or deterrents to protect against the adult or fly depositing her eggs on the leafage.

According to *Canadian Entomologist*, Dr. Alfred E. Cameron has been appointed a field officer of the Entomological Branch, Ottawa, Canada, and will be specially charged with the investigation of the pear thrips and other insects in British Columbia. Dr. Cameron graduated from the University of Aberdeen in 1909, received the degree of Master of Science from the University of Manchester in 1912, and after holding a Government Scholarship and conducting investigations in England and the

United States, he received the degree of Doctor of Science in 1915 from Aberdeen University. In 1914 Dr. Cameron conducted practical spraying experiments at the New Jersey Agricultural Experiment Station under Dr. Headlee.

Mr. D. J. Caffrey, of the Maxwell, N. Mex., station of the Bureau of Entomology, reports an unusual scarcity of the larvæ of *Hemileuca* this season. A long period of drought has apparently resulted in the prevention of the hatching of the eggs of the range caterpillar. Mr. Caffrey is having great difficulty in securing enough caterpillars to furnish food for rearings of the predaceous enemies of the range caterpillar. The heads of field stations of the Bureau are therefore asked to send to Mr. Caffrey lepidopterous larvæ of any kind which may be used as food for Calosoma beetles or as hosts for the Tachinid fly, *Compsilura con innata*. These larvæ should be packed in such a way as to reach Mr. Caffrey alive and in as good condition as possible.

Mr. T. E. Snyder, Bureau of Entomology, left Washington on May 9 to investigate the character and extent of damage to "Australian pine" trees, *Casuarina equisetifolia* in southern Florida, by a buprestid beetle, *Chrysobothris impressa* Fab., an insect presumably introduced into this country. According to W. S. Fisher the species occurs in Dutch Guiana, Santo Domingo, and probably in Cuba. The Australian pine, a rapid-growing, graceful tree, is planted in large numbers in southern Florida in groves along roadsides and land developed along the seacoast. This buprestid breeds in the native red mangrove tree in nearby swamps, and had previously been collected at Key West by E. A. Schwarz. The larvæ of the beetle girdle the cambium of the young Australian pine trees and badly disfigure, greatly weaken, or kill the trees.

According to *Science*, The California State Board of Health, in coöperation with the University of California, is conducting a state-wide malaria mosquito survey under the supervision of Professor W. B. Herms, consulting parasitologist for the state board and associate professor of parasitology in the University of California, who is assisted by Mr. S. B. Freeborn, instructor in entomology. The work began on May 10 and will continue through the summer. Probably three summers will be required to complete the survey of the entire state. The party travels by automobile, collecting mosquitoes, locating their breeding places, determining the presence or absence of malaria, distributing literature, lecturing and giving information on ways and means for the control of the insects. The Sacramento Valley and the northeastern portions of the state to the Oregon and Nevada state lines have already been covered. Thus far endemic malaria has been found at a maximum elevation of 5,500 feet and the Anopheline carriers have been located. Two or three new species of mosquitoes have been found.

Insects as Food for Man. Now that the season of insect activity is on again, attention of field workers is called to the desirability of experiments on the edibility of insects. Recently *Lachnosterna* larvæ have been made into a salad by Dr. Langworthy of the Office of Home Economics, and this salad has been tasted by about a dozen men in the Bureau, who found it not at all disagreeable. A broth was also made, which Mr. O'Leary and the writer found very good. Mr. Craighead told me yesterday that he had been trying Cerambycid larvæ fried in butter, and, while he is not enthusiastic, he pronounces them edible. I will make no suggestions as to method of preparation, but will leave that to the ingenuity of any who have a chance to experiment.

L. O. Howard

Mailed August 17, 1916